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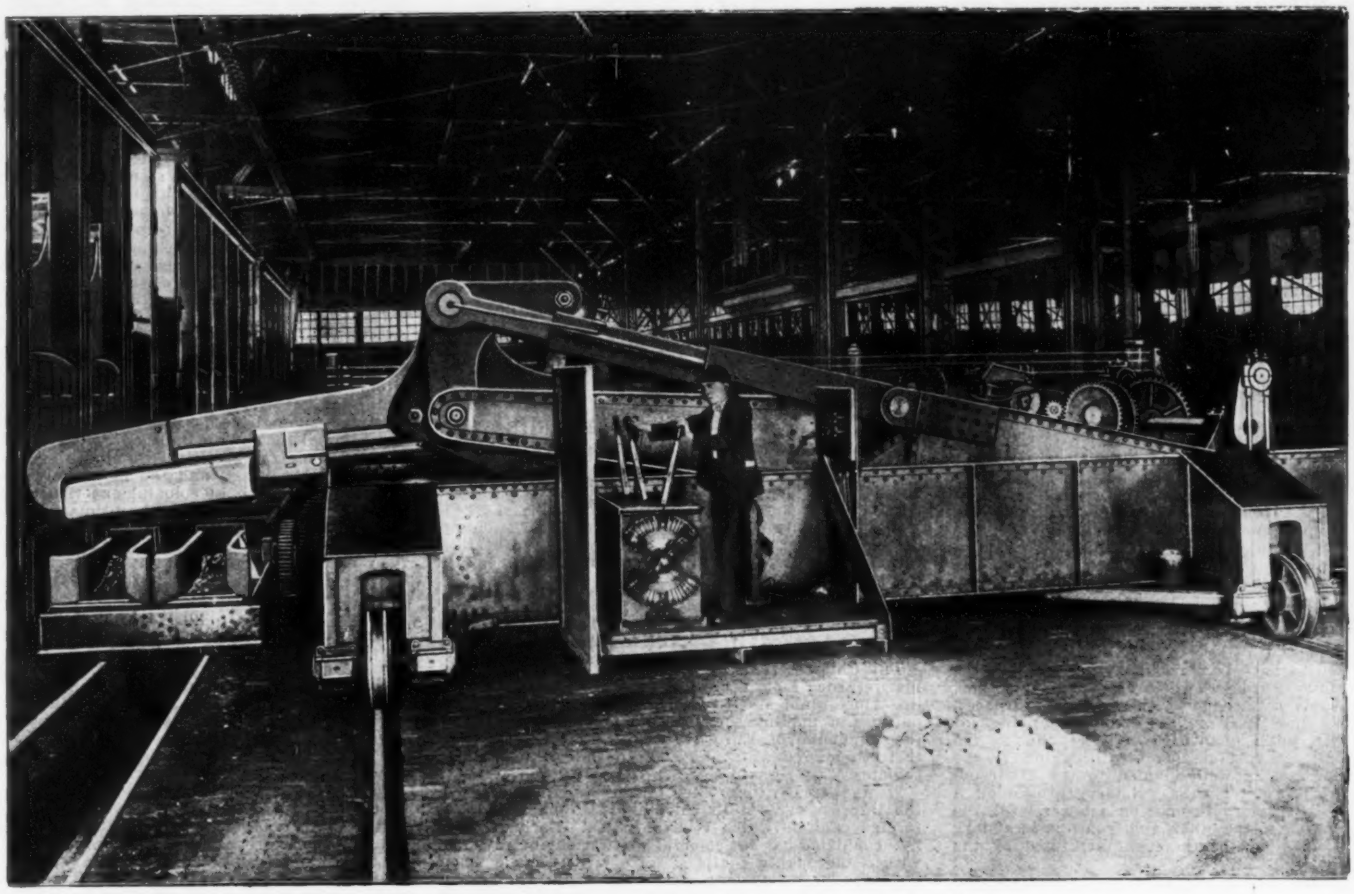
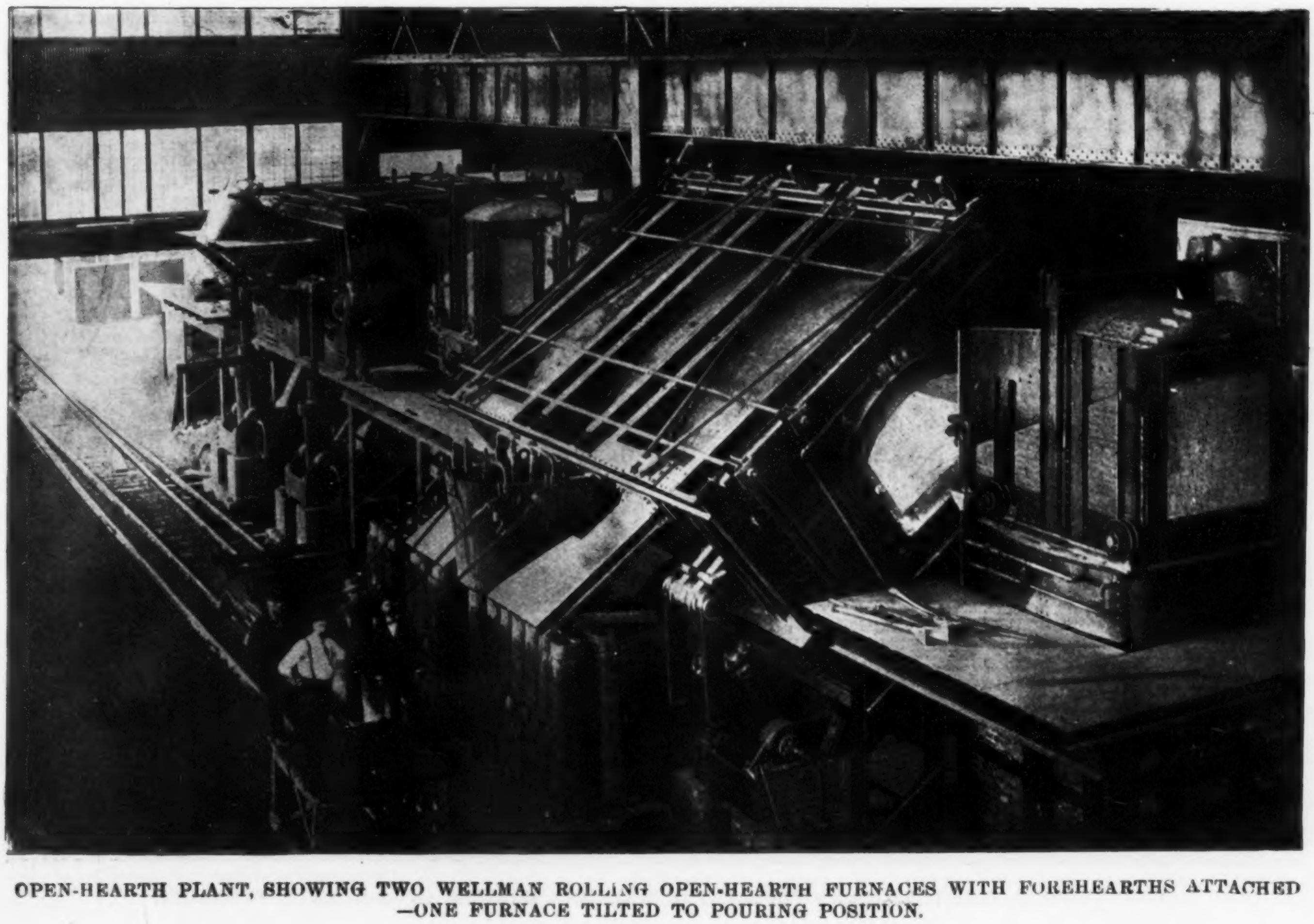


LOW TYPE HEATING-FURNACE CHARGING MACHINE.



OPEN-HEARTH PLANT, SHOWING TWO WELLMAN ROLLING OPEN-HEARTH FURNACES WITH FOREHEARTHS ATTACHED —ONE FURNACE TILTED TO POURING POSITION.

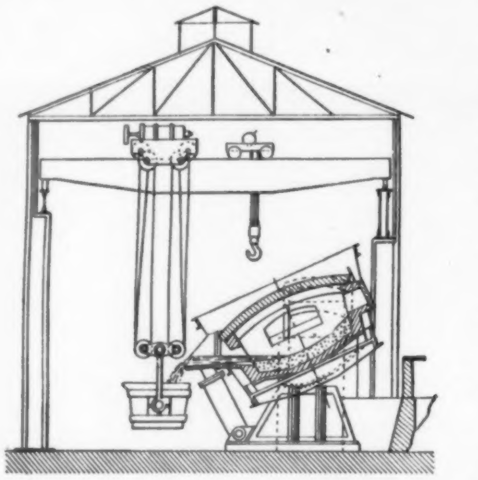
OPEN-HEARTH STEEL MELTING FURNACES.

Our engravings represent some of the new plants which have been installed in accordance with the latest engineering practice by the Wellman-Seaver Engineering Company, whose main office and works are located at Cleveland, Ohio. Metallurgical plants must be built, in the present day, with the greatest possible attention to economy in the smallest detail, and just as soon as a plant becomes in the slightest degree obsolete it must be "scrapped" and new machinery installed. We present only a few of the metallurgical devices constructed by this firm, but they will serve to give an idea of some of the modern methods of open-hearth steel making.

The Wellman rolling melting furnace which is now being largely adopted as the leading type of steel-melting furnaces, has been constructed in capacities ranging from 3 to 100 tons per heat. In its present perfected form it embodies sound mechanical principles as applied to furnace building, the bricklayer supplementing the work of the mechanic. The furnace consists of a very strongly framed steel shell or casing, and an approximately rectangular section inside of which the lining of silica bricks is built up. On the under side of the structure are fixed two curved cast-steel rockers which are supported by and roll on strong steel standards with horizontal upper surfaces; when tilting to pour off the mass, the furnace moves forward on these rockers. The rolling movement is accomplished by two hydraulic cylinders mounted on trunnions at their lower ends and having the upper ends of the piston rods attached to the pouring side. To tilt the furnace, water is admitted to the top end of the cylinder. In case of accidental failure of the hydraulic system the furnace returns by its own weight to the normal melting position. A special feature of these furnaces is the water-cooled front and doors, greatly reducing the danger of the men becoming overheated while employed in front of the furnace. The forehearth is a kind of special ladle attached to the front of the tapping hole. It enables molten steel to be poured direct into the ingot molds and dispenses with the ordinary ladle. It is a box-like structure with a flanged opening on one side corresponding to the tapping hole to which it is bolted. It is brick-lined and is provided with two nozzles and stoppers. When the furnace is tilted the metal flows into the forehearth, standing at the same level as in the furnace, and is then tapped direct through the nozzles into ingot molds which are brought under the forehearth on trains of casting cars. Each car carries two molds placed the same distance apart as the pouring holes, whereby two molds can be filled simultaneously. A pouring spout may be readily substituted for the forehearth in case it is necessary to tap directly into a ladle on wheels or suspended from an overhead crane.

The rolling furnace is particularly adapted for the Talbot continuous process, which has, up to this time, been exclusively carried on in the Wellman furnaces. The furnace lends itself to the frequent tappings of comparatively small quantities of steel and to the pouring off of the surplus slag by tilting toward the charging side. It is well adapted to the Bertrand-Thiel duplex process, with a primary furnace on a higher, and a secondary furnace on a lower level, the transfer from one to the other, and from the secondary furnace to the molds being much facilitated by the rolling action.

The open-hearth furnace charging machines and charging boxes made by this company are sold all over the world. They are made in two types; the high type, which is largely used on account of its greater economy of floor space, and the low type. The train of cars loaded with the charging boxes having been drawn in front of the furnace, the machine is moved by its longitudinal traverse motor until the end of the large bar is exactly over the box to be charged. If the box is not exactly in front of the door through which it is to be charged, the machine is moved along the track to the proper place, taking the whole train of cars with it; in fact, the machine may be used as a shifting locomotive. When in the proper place the charging bar of the box is lifted, the furnace door is opened and the box is run into the furnace. The charging bar, now rotated by the motor, turns, inverting the box and emptying its contents on to the bed of the furnace. It is then quickly run out of the furnace, being reversed at the same time and replaced on the car. The operation is then repeated with the next box, and so on until the furnace is fully charged.



SECTION OF FURNACE AND FOREHEARTH.

Our third engraving shows a heating-furnace charging machine for charging ingots or slabs into heating furnaces and withdrawing them from the same. Its construction will be readily seen by reference to the engraving.

INTEREST IN COLONIAL MATTERS.

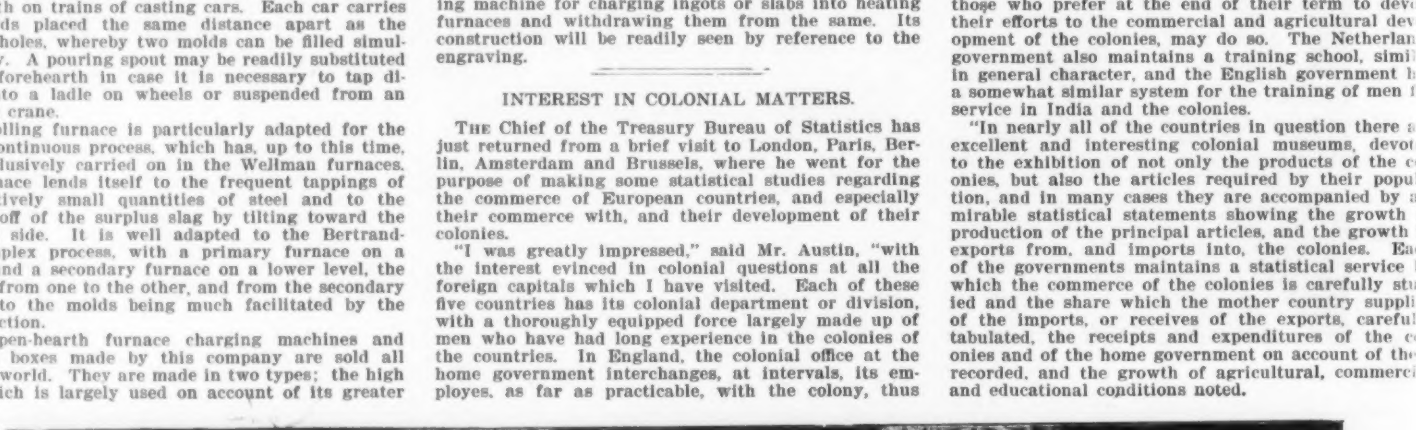
The Chief of the Treasury Bureau of Statistics has just returned from a brief visit to London, Paris, Berlin, Amsterdam and Brussels, where he went for the purpose of making some statistical studies regarding the commerce of European countries, and especially their commerce with, and their development of their colonies.

"I was greatly impressed," said Mr. Austin, "with the interest evinced in colonial questions at all the foreign capitals which I have visited. Each of these five countries has its colonial department or division, with a thoroughly equipped force largely made up of men who have had long experience in the colonies of the countries. In England, the colonial office at the home government interchanges, at intervals, its employes, as far as practicable, with the colony, thus obtaining practical and experienced men in the home office, and keeping a corps of men in training in the colonies. At the Netherlands, whose colonial work is a matter of pride on the part of every citizen of that country, the head of the Colonial Department has had long experience in Java, the principal Netherlands colony, and one which has been eminently successful. In France, the Colonial Department is extremely active, obtaining large numbers of reports from its colonial officers and distributing information by a specially organized bureau for that purpose, and in Germany and Belgium equal interest was manifested.

"Everywhere I found great public interest in colonial matters outside of official circles. In London, for instance, there is a Colonial Institute, composed of several hundred ex-officials of the colonies and others interested in colonial matters, which has a library of nearly 50,000 volumes and which is in close working relation with the library of the Colonial Department, also containing 50,000 volumes. The members of the institute hold monthly meetings for the discussion of matters pertaining to the management, commerce, statistics, and prosperity of the colonies and their commercial relations with the mother country. At Paris there is a colonial organization, with about 5,000 members, some of whom have had experience in the colonies, others are merchants and business men desiring to keep in constant touch with business conditions and opportunities in the colonies, and still others who are students of colonial subjects from an economic standpoint. In Germany, although their colonial system is young as compared with those of England, Netherlands or France, the Colonial Association numbers over 20,000 members, scattered throughout the empire, some of whom are officers and ex-officials, others connected with the army and navy, and many others who are interested in the commercial and agricultural development of the colonies.

"The study of colonial conditions and development of the colonies, both as to products and commerce, is encouraged by all the governments which control territory of this character. The French government maintains an educational institution devoted exclusively to colonial studies and the training of men for the colonial service; admission to its classes is obtained through competitive examinations, the term of study is three years, and the instructors are men of high standing both in colonial experience and in the study of economics. While the primary object of this institution is to educate men for the colonial service, those who prefer at the end of their term to devote their efforts to the commercial and agricultural development of the colonies, may do so. The Netherlands government also maintains a training school, similar in general character, and the English government has a somewhat similar system for the training of men for service in India and the colonies.

"In nearly all of the countries in question there are excellent and interesting colonial museums, devoted to the exhibition of not only the products of the colonies, but also the articles required by their population, and in many cases they are accompanied by admirable statistical statements showing the growth in production of the principal articles, and the growth in exports from, and imports into, the colonies. Each of the governments maintains a statistical service by which the commerce of the colonies is carefully studied and the share which the mother country supplies of the imports, or receives of the exports, carefully tabulated, the receipts and expenditures of the colonies and of the home government on account of them recorded, and the growth of agricultural, commercial and educational conditions noted.



OPEN-HEARTH PLANT, SHOWING FOUR 50-TON WELLMAN ROLLING OPEN-HEARTH FURNACES.

"Especial attention is given in all cases to the ability of the colony to meet the commercial wants of the mother country. Countries which do not produce within their own borders the foodstuffs and raw materials required by their population, encourage the production in the colonies of the articles thus required at home, while the countries which produce their own foodstuffs or raw materials look to the colonies for the tropical products which they cannot produce at home and encourage the production of those articles in the colonies and their distribution in the mother country. The investment of home capital in the colonies is thus encouraged through the assurance given that the products of those colonies will find a ready market in the mother country, the manufacturers and producers of the mother country are, in turn, assured of an enlarged market in the colonies through the increased consuming power which accompanies their increased production and sales, and the general prosperity of the colonies through increased production, larger markets and better roads, railways and improved educational facilities, is thus assured."

ART CANONS—HISTORIC AND PREHISTORIC.*

By Prof. Thomas Wilson, Department of Prehistoric Anthropology U. S. National Museum.

Art is the manifestation of human emotion externally by expressive arrangements of line, form, or color, or by a series of gestures, sounds or words, and by perfect rhythmical cadences. This definition is general and includes all kinds of art. Emotions, whether grave or gay, are thus manifested or interpreted: when by line, through drawing or engraving; when by forms, through sculpture; and a combination of these produces architecture. When the emotion is manifested by gesture or rhythm of movement it produces the dance; when by rhythmic note, music; when by rhythmic words, poetry.

How or why the emotions are thus produced belongs to psychology and is not to be argued here, though enough may be said to show the relation of art to prehistoric man.

The expressive arrangements of color, line and form which make the respective arts of painting, sculpture, drawing and architecture, operate usually to produce pleasure and gratification in the human subject. Professor Jastrow, of the University of Wisconsin, has published a paper in the Popular Science Monthly on "Popular Æstheticism in Color," being the result of practical experiments made by him wherein 4,556 persons submitted themselves to tests as to their taking in, or preferences for, color. Blue was the most popular; then red. The two least popular colors were orange shading toward red, and yellow. Dividing the records into four fundamental equal parts, blue constituted the first quarter; red, lighter blue or blue-violet the second; red, lighter red, violet and "no choice," with greens and yellow, the third portion; and the relation of these colors in the scheme, the last quarter. Darker colors were preferred to light colors; primary to secondary or any combined color. Grouped according to age, it was discovered that the younger persons (under eighteen years of age), showed the greater preference for red; the girls, for lighter red, though preference for blue increased with age; while violet was avoided. Grouped by sexes, blue was the masculine favorite and red was the feminine. Out of every 30 males, 10 were for blue and 3 for red; and out of every 13 females, 4 were for blue and 5 for red. Whatever may have been the cause, whether hereditary or from pure caprice, the fact remains that these differences in taste exist and that, considered primarily and independent of education or training, they are natural and involuntary.

The fundamental conditions of pleasurable sensations are economy, variety and intensity of vibration in their relation to the molecular movement of the nerve centers of the individual. Each art is a peculiar language of a more or less extensive range of ideas, and to which it alone is capable of giving adequate expression. Certain of the arts appeal to the organ of sight: painting, sculpture and the dance; while certain others, to the organ of hearing: poetry, music and the drama.

The laws governing both groups are the same. In order to their success, both require concord between the ethereal vibrations and the nerves which convey the impressions to the nerve centers. A work of art is a material expression of pleasurable emotion. It excites the nerve centers and produces sensations of pleasure: we see or hear the artist's ideal through his work, and the success of his effort as a work of art depends first upon his brilliancy—upon his clearness of perception of his ideal—and, second, on his ability to translate and render his impressions correctly. A copy, even of the most beautiful scenes in nature, is not art. No artist can hope to reproduce motion as faithfully as the work of the camera. A work of art is the idea of the artist: it is a part of himself—not nature as it actually *is*, but as he *sees* it; as he idealizes it and depicts it. It is this ideality of artistic genius which produces the sensation of delight.

So much for the elements of the work of art. We pass now to the genius by which a work of art is produced.

Genius consists of the superior perceptive power on the part of the individual arising from an unusual excitement and activity or an exaggerated sensibility and elasticity of certain nerve centers. The principal manifestation of genius is the power to create—the something which renders the artist peculiarly open to the pleasures of the eye and the ear. The individual who may receive these impressions is overcome by them and he says or feels he is possessed as with a demon and cannot be at ease unless his work is essayed. A notable difference between talent and genius is that talent *can*, but genius *must*. The poet has no larger brain, no clearer reasoning power than the general professional or business man, yet he has some emotional characteristics which may differentiate him from any other.

Artists—whether poets, painters, engravers, sculptors, or archæologists—differ in their genius, all having profound and brilliant imagination, the use of which makes the principal difference between them and other men. It has been recognized since Plato's time that the line between genius and insanity is very fine and in many cases difficult to determine. One of the philosophers maintained that the grave, only, separated the genius from the madman. The excavation of some archæologists emphasizes, though it does not prove, his proposition. The substitution of his uncontrolled imagination for the ordinary mental processes may produce a remarkable genius not unamenable to reason but who, while not insane, certainly lacks judgment in the affairs of every-day life. Have we not knowledge of certain geniuses in poetry or art who are profound in classic learning, brilliant in imagination, happy and felicitous in expression—writing beautiful poems—yet, when they are confronted with the ordinary duties of mankind and the problems of every-day business, their judgment it without value? Such a one was Oliver Goldsmith.

One must not confound the conditions and characteristics of a critical intellect with those of artistic genius. The intellectual requirements for artists and art critics are dissimilar: the critic has but one thing in common with the artist, and that is his love of art. Their habits of thought are otherwise opposed. The critic depends on calculating reason and calm judgment; his ability depends on his power of analysis. The artist thinks through his imagination and represents his ideas under an inspiration: he sees them through his mind's eye finished in all their parts. It may fairly be stated that no art work was ever successful wherein the artist had to grope and seize after his ideal—where he sought for his motive step by step in a questioning manner. Some of the best works in the arts of painting, music, and poetry are those done in the shortest space of time. Some of the best painting works were completed in a single setting. Burns completed his poem, "Tam O'Shanter," in a single walk and wrote it out at a single sitting; Bryant wrote his "Thanatopsis" in eight days, and Handel composed "The Messiah" and Haydn "The Creation" in paroxysms of terror.

The artist has sudden hallucinations wherein he calls up from his storehouse of memory such impressions as have been created there in dreams. No operation can be more unlike this than the patient cogitation of the philosopher or man of science who, proceeding from one point to another, from one discovery to another, surmounts his difficulties seriatim and by a process of ratiocination finally arrives at a certain and satisfactory conclusion. The scientific men talk of personal equation and seek to eliminate it as far as possible. When this cannot be done, they make the necessary allowance. The artist, on the other hand, glories in his personal equation and considers that his best work which contains most of it. In him, personal equation stands for imagination, inspiration and sometimes for hallucination.

Taste is genius in a small way—the capacity to perceive a good thing; and the clearer and more correctly it is perceived, the better is the taste. Any general can win a battle if he is given the next day to determine the position of his armies. Taste and ideals, considered intellectually, are synonymous. Man's desires are in accordance with his ideals and taste: they govern his actions. Man's ideals are the evidences and records of his culture; and the changes in these ideals are the foundations of human progress and civilization. The value of a work of art is not necessarily to be measured by its beauty nor the amount of pleasure it gives to the beholder or listener; indeed, it may be the reverse: it may derive its value from the inferior perceptions. Shakespeare's tragedies are not always pleasurable. Some of them in the hands of certain actors excite feelings of horror and dread.

The art of the dance and poetry, when scientifically compared, is produced in much the same manner. There must be the same movement and vibration, with corresponding vibrations in number, intensity and duration extending to the nerve centers and resulting in sensations of delight. There is architecture in art, as there is art in architecture: a ballet is built up as much as is a poem. They have their beginning, middle and ending: prologue, interlude and epilogue. The rules of rhetoric provide for the construction of oratorical, literary and art work. An oration has its exordium, etc. The rules governing all these are as direct and as carefully laid down as are those of the planning or construction of a palace or temple. The art of oratory is not considered here. Oratory consists purely of words which express ideas; and ideas and words together are more the result of intellect than they are of art, though there is a great deal of art in oratory. The same words used by such orators as Clay, Wendell Phillips, Thomas Jefferson, have a vastly different effect upon their audiences than when delivered by an unsympathetic reader or even an ordinary speaker. This difference shows the art of oratory. Orators and sages follow the same rules: there must be harmony, variety and intensity of vibrations exciting the corresponding harmonious movements of the nerve molecules and producing the appropriate sensation in the nerve centers, or the work will be condemned. The consecutive construction of the various parts of a poem or of a drama is as equally well regulated as are the foundations of a wall or edifice. All architecture requires a harmony, variety and intensity of vibrations and, if satisfactory and artistic, it must produce the same kind of sensory activity. We can see how architecture is equally entitled to a place among the fine arts.

Man had, in prehistoric times, the same sensations of pleasure and the same love of art as in historic times. Man's appreciation depends on the sensation or sensory activity produced by the molecular movement of the nerve centers. This is true of man's intellect; and so his taste for art had its origin and rise with his intellect and was naturally a part of him. His taste for art, and his pleasure in it, pushed him to its indulgence at the earliest moment. Art was the germ of civilization instead of being its flower or fruit. This may be considered as a theory, and without value; but when we investigate the facts concerning man in antiquity and find that he actually made works of art: first, for utility; second, only for beauty; third, to gratify his taste; and, fourth, to give him pleasure, then we may consider it demonstrated that ancient man had the same art emotions as modern man; that he had certain ideals relating to the animals with which he was acquainted and consciously sought to represent them by engraving or etching on bone or ivory, the only suitable substance at hand. Thus, it accords with the facts to say that he made these art objects from like motives and influences as does the modern man; and, finally, it may be said of this art—of this art instinct of prehistoric man—as certainly as it can be said of other of our instincts—self-preservation, etc.—that it was born in him, and was part of him.

An obvious distinction in art is that between the material and physical, and the spiritual or psychological. An artist may be able to paint a beautiful picture or carve a beautiful statue—one exciting the highest pleasure of the beholder—and yet not be able to make a lasting impression upon the mind. He has the technique, but not the science, of art. The material and physical sides of poetry, painting and sculpture may be different among different people, but the spiritual and psychologic sides are the same for all. This is the foundation of the science of beauty in art.

The earliest known manifestation of human art consisted of the chipping instruments of flint. This was in the Palæolithic period of the stone age, which has been divided according to the progress in human culture and diverse names have been given thereto: such, for instance, as those of the animals associated with the implements: respectively, the cave bear, the mammoth and the reindeer. Some authorities, again, have divided it into only two, naming them after the mammoth and the reindeer.

The earliest stage of human savagery was marked by no tribal organization, no sociality, no belief in a future state, no known system of religion: man did not bury his dead; he erected no monuments; built no houses, he had no local habitation; dwelt in no villages. He was not an agriculturist—only a hunter and a fisher; yet he held in the remotest epoch the highest rank as a hunter and fisher, and a correspondingly high place as an engraver on bone and ivory. His material was the bones and tusks of the animals which were his prey; his tools were sharply chipped points or gravers of flint; most of the specimens of art work were fashioned in caves. No one has sufficient knowledge to pretend to explain why specimens of this art work belong to Western Europe; but certain it is that most of the known specimens have been found in that country, being chiefly in the caverns of central and southern France; and while 400 specimens have been found and preserved, no one knows how many have been missed, or remained undiscovered. The specimens were originally thrown aside and lost in the debris. In making these excavations there is nothing to guide the searcher to the place where they are likely to be found. He must depend upon his experience and his fortune. The specimens are usually enfolded in blocks and slabs which became hardened and must be quarried out like stone. A few specimens of the art work of the Palæolithic period were purely decorative; but for the most part, the objects were the animals of the period and the locality. Many animals now extinct are represented and, in this way, knowledge of their appearance has been preserved. The animals most frequently engraved are the mammoth, cave deer, musk-ox, reindeer, chamois, horse, deer and other animals; and, finally, man. The marine animals were the seal, sea-lion, tortoise, fishes and turtle. Some of the objects were purely ornamental, while others were utilitarian. During all this period there was only the slightest attempt on the part of the artist to represent living or material objects. The decorative art of that period consists mostly of designs in geometric bars: as squares, circles, chevrons, etc.

Man became, in the bronze age, sedentary and had a love of beauty; had a religion, and at last buried his dead as though in the recognition of a future state. He built houses, constructed fortresses, built tumuli and erected carved stone obelisks, sometimes in groups or circles and lines which are called cromlechs. He acquired the art of an adept in shaping, grinding, polishing and milling stone, especially the hard flint and the tough jade, of which he left magnificently wrought specimens.

The American Indians and his congeners upon the West Indian Islands and Antilles, though less finished artists, in some respects, excelled their European brethren in making rude drawings and pictures, principally petrographs—many of them, doubtless, ideographs, telling a story. They often reproduced the human figure. The aborigines of Central and Northwestern America, and of Mexico, in the stone age reached a higher civilization, mainly manifested by their temples.

* Extracts from a lecture delivered at the Free Museum of Science and Art, University of Pennsylvania. Prepared by Special Correspondent of Scientific American.

PETROLEUM.

In the quarter century from 1876 to 1900 the total value of mineral oils exported from the United States was about $1,200,000,000, an average of about $48,000,000 a year, and during recent years has averaged about $60,000,000 per annum, or $5,000,000 per month, says Mines and Minerals.

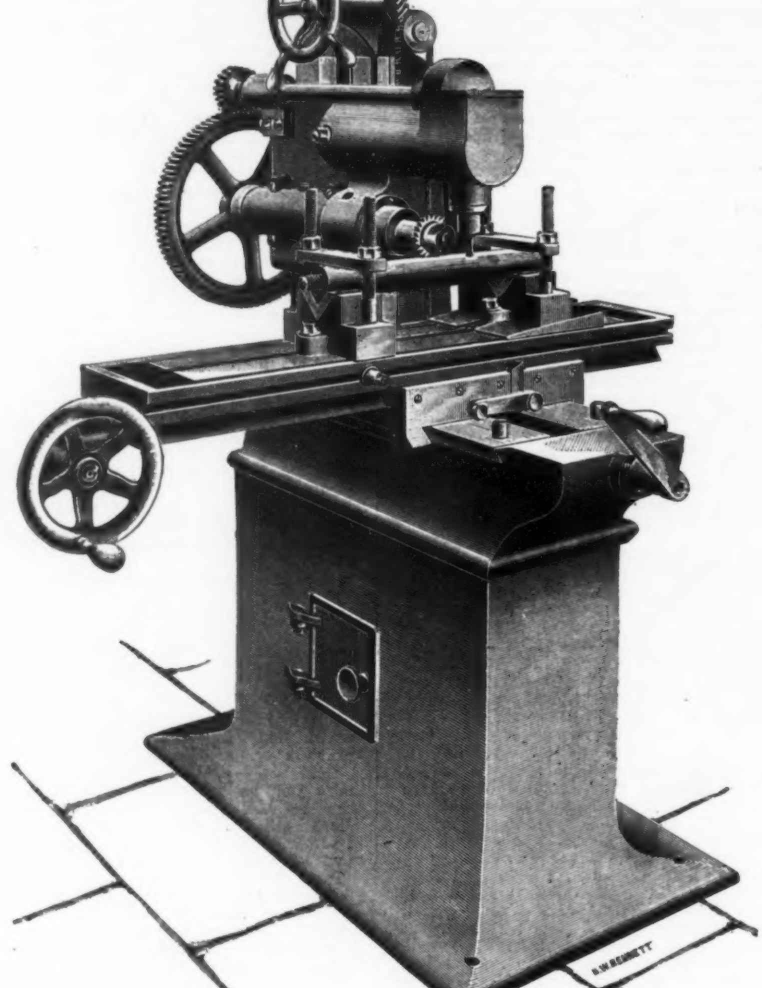
In the mere question of gallons of oil produced, Russia has been for years a close competitor of the United States, though it is probable that the recent discoveries in the United States will enable it to continue to lead in the number of gallons produced; while the fact that American oil produces nearly twice as much refined illuminating oil from a given quantity of crude as does the Russian oil, adds greatly to its value as a commercial product. One especially interesting feature of the development of the oil industry is that there has been a remarkable decrease in the price to the consumer during the period in which the actual exportations and the net value of the exports have been increasing. The average value of the illuminating oil exported in 1876 was about 15 cents per gallon, and in 1877, an exceptional year, 20 cents per gallon. By 1881 the price had fallen to about 10 cents per gallon, the

figures for that year being 332,000,000 gallons, valued at $34,000,000. By 1891 the average price was about 7 cents per gallon, the exports of that year having been 564,000,000 gallons, valued at $41,000,000. By 1898 the average export price was about 5 cents per gallon, the quantity exported having been 824,000,000 gallons, and the value reported to the Bureau of Statistics by exporters through the customs collectors $42,922,682. In the nine months of the present fiscal year for which the figures are completed by the Treasury Bureau of Statistics, the total exports of illuminating oil amounted to 569,624,751 gallons, valued at $37,939,514, or 6 2-3 cents per gallon; while the total value of all mineral oils exported, including crude, lubricating, and illuminating oils, naphthas, and residuum, was $52,745,096, and for the full fiscal year seems likely to amount to $70,000,000.

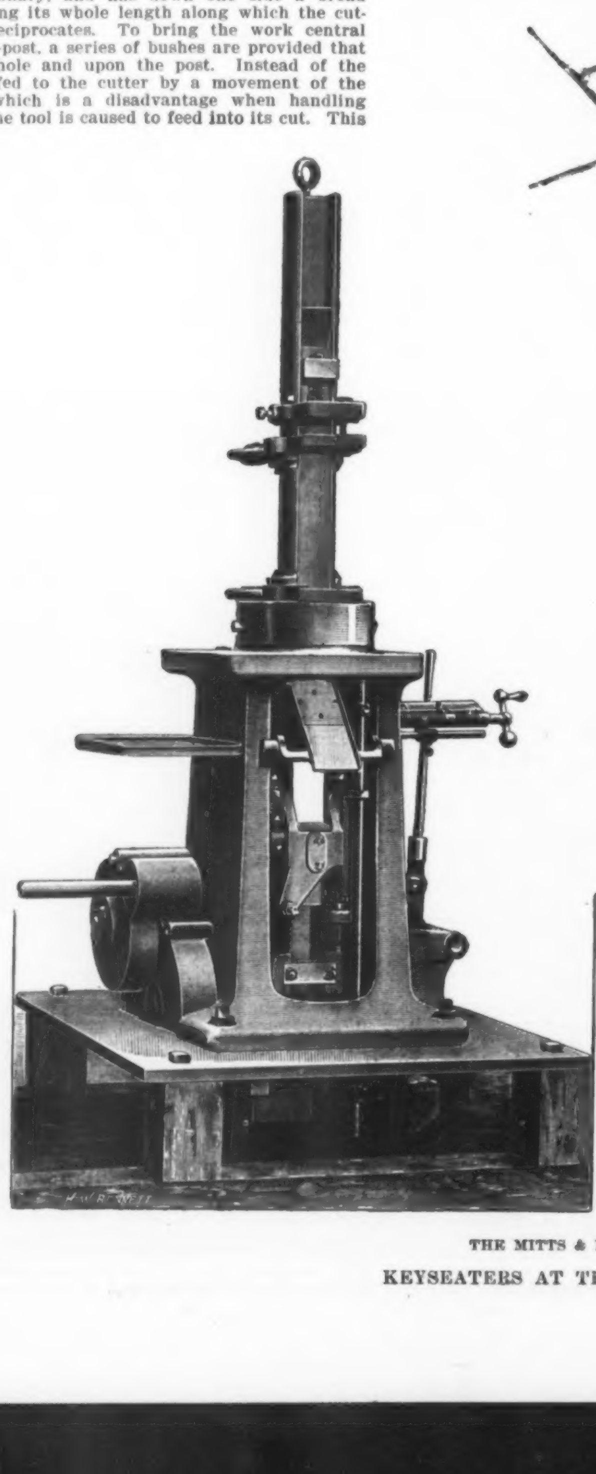
KEYSEATERS AT THE GLASGOW EXHIBITION.

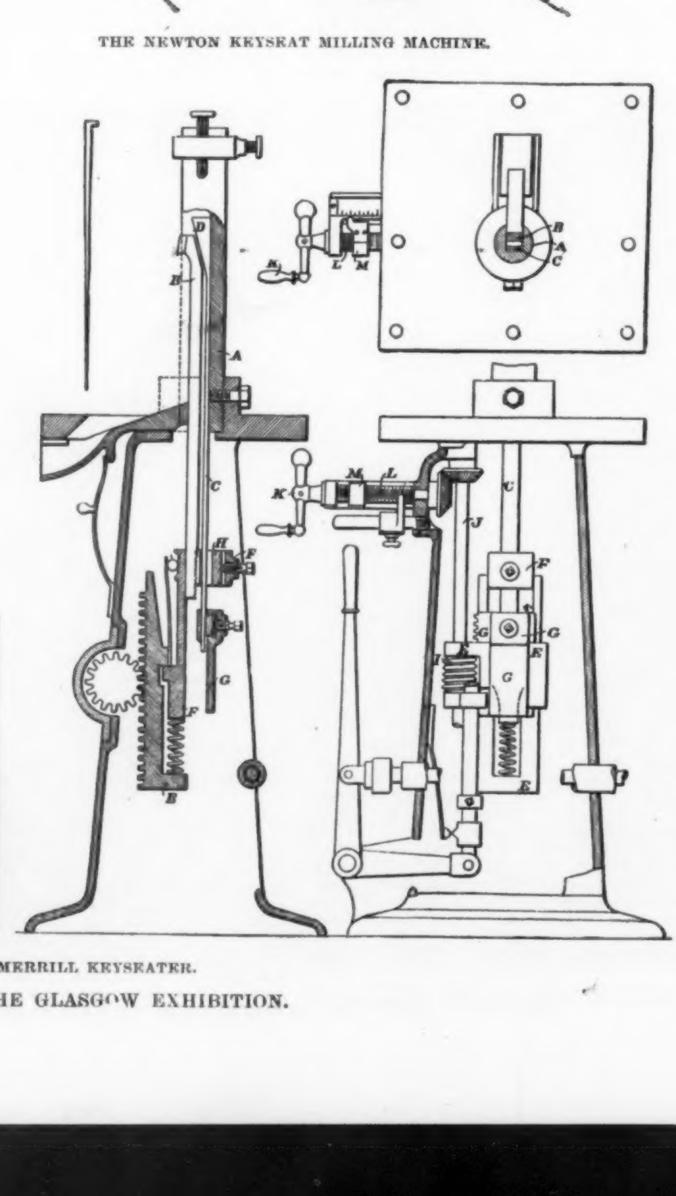
For many years we have been familiar with several different kinds of keyway cutting machines for machining the slots in shafting; but, in this country, we have been rather less familiar with the type of keyseater used for internal work. It has been the general British practice to prepare inside keyways on slotting machines, which, it must be confessed, are somewhat cumbrous and unhandy for the work. In fact, the slotter becomes useless for cutting the keyways of flywheels of moderate size that are made in one casting. It has, therefore, been necessary for machinists to adopt various expedients, such as forward projecting tools in the shaping machine, for doing this class of work. The introduction, some years ago, of the inverted type of keyseater, placed a tool at the disposal of the machine shop, which very much simplified the execution of this kind of work. Not only has it facilitated the cutting of key-grooves, but it also is most useful for internal slotting; as, for instance, the cutting of the teeth of inside ratchet wheels, of polygonal-shaped holes, internal gears, etc.

There is one other machine of the inverted type which may be found at the stand of Messrs. C. W. Burton, Griffiths, & Co., of London. The name given to it by the manufacturers, Messrs. Mitts & Merrill, of Michigan, is the "Giant" keyseater. This machine we illustrate. As will be seen on reference to these views, there are a number of points of difference between this and the machines just referred to. There is not, for instance, a back standard with overhanging arm to form a top guide to the cutter-spindle. Instead of this, there is a post, *A*, which passes through the interior of the hub in which the keyway is to be cut. This part is stationary, and has down one side a broad groove running its whole length along which the cutter-bar, *B*, reciprocates. To bring the work central with the tool-post, a series of bushes are provided that fit into the hole and upon the post. Instead of the work being fed to the cutter by a movement of the work-table, which is a disadvantage when handling heavy jobs, the tool is caused to feed into its cut. This feed is obtained by inserting within the tool-post and at the back of the cutter-bar a second bar, *C*, that has a wedge, *D*, at its upper extremity. The cutter-bar and this wedge-bar reciprocate together; but in order to put on the cut, a slight relative motion may be given. For the purpose of the drive, the crosshead, *E*, is provided with a rack which is driven both ways by a pinion, and this latter is driven from forward and backward driving pulleys through the medium of clutches. During the upstroke the tool is automatically relieved about 1-16 inch, to prevent it dragging on the work. This is obtained by connecting the cutter-bar,



THE NEWTON KEYSEAT MILLING MACHINE.





THE MITTS & MERRILL KEYSEATER.

KEYSEATERS AT THE GLASGOW EXHIBITION.

B, to the loose holder, F, which is so attached to the crosshead as to admit of a slight relative motion between them on the upstroke. The wedge bar, C, is independently connected to the crosshead. It will be seen to pass through the upper part of F at H, and to be secured to the clamp block, G. This block is cut with worm teeth on its side to mesh with the worm, I, which is in turn carried by lugs on the side of E and slides upon the vertical splined shaft, J. At the upper end of J there is a pair of bevel wheels making communication to the handle, K. To regulate the cut, the action then is—a rotation of K causes a corresponding turning of the worm, I; this, by regulating the relative positions of E and G, causes a corresponding regulation between the cutter and wedge bars to which they are respectively attached. When a number of keyways are to be cut of the same depth, the adjustment of the cutter is gaged by the aid of the screw, L, cut upon the spindle carrying the handle, K. As the handle is turned, the nut, M, moves horizontally until it engages an adjustable stop immediately below, this deciding the depth of the keyway. If the keyways are required to be taper, a long wedge, which may be seen to the left of the pillar, is placed within the groove of the post, A, at the back of the wedge bar. This gives all of the tapered keyways a standard taper. By the aid of adjustable tappets, the stroke of the cutter can be varied to any extent within the full range of the machine. The chief claims that are made on behalf of this machine are that it is quite clear overhead, there being nothing to interfere with the handling of the work, and that the tool cannot spring because it has a solid support the whole length of the stroke, making the keyseat perfectly straight, without any springing at either end.

All machinists agree that when producing a number of articles alike it is advisable to use roughing and finishing tools, the latter having as little work to do as possible, so that it may retain its cutting edges and finish the work accurately to size. The Newton keyseat milling machine, exhibited by Messrs. Charles Churchill & Co., is provided with two cutters for the sake of this accuracy of finish and also for speed of execution. An ordinary face milling cutter will remove metal at a much faster rate than an end mill, but it will not give the shape of keyway usually required. In the Newton machine an ordinary milling cutter, the width of keyway required, is mounted upon a horizontal arbor, and an end mill is fixed upon a vertical arbor in line with the former. The first operation in cutting the keyway is to rough out the key groove with the cutter on the horizontal mandrel, and the work table is then moved over until the end mill is in position for the second operation to complete the keyseat. To insure accuracy of location the following arrangement is made: The work table has four stops, two at the front and two at the back; these are so set that the V-blocks carrying the shaft to be splined come central with the cutters—the front pair of stops locating to the vertical finishing mill and the back pair to the roughing cutter on the horizontal arbor. When the front pair is once set to bring the V-blocks central with the vertical spindle, it is right for any width of cutter; but not so with the roughing cutter, unless special provision is made to bring the center of the cutter thickness always in the same place, irrespective of the actual thickness of the cutter. For this purpose, packing washers, of various widths to suit the different cutters, are provided, and these are always kept with their respective cutters, so that the wrong one may not inadvertently be used. These washers are placed on the arbor before the cutters, thus bringing the latter to their correct positions. The stops, therefore, should not often need to be adjusted. If properly handled, the machine should mill a large number of key grooves accurately to size and at low cost.

PATENT CYLINDERS FOR SINGLE-ACTING RAM PUMPS.

DURING a recent visit to the works of Frank Pearn & Co., Limited, engineers, West Gorton, Manchester, we were shown a new type of pump with patent cylinder for single-acting ram, which they had just completed, and of which we are now able to give illustrations. The object of this invention, which is a simple method of compounding steam cylinders, is to increase the efficiency of pumping engines with single acting rams. The staging of the steam through cylinders of economical ratios is so arranged that the work of pumping is entirely direct from the cylinder to the pump ram, without passing any of the strains through the working parts, viz., the connecting rod and the crank shaft. In single-acting pumps with ordinary steam cylinders, one-half the work is transmitted through the crank shaft and connecting rods, and there is a liability to failure in working, due to this extra work being passed through the shaft; every revolution, in fact, causes unnecessary wear and liability to breakdowns. By the improved system of compounding under notice, however, live steam is admitted on the forcing stroke only, and after the completion of the stroke, this steam is again used in the larger cylinder partly for the suction, and the remainder for forcing on the next down stroke. The pressure given out throughout the stroke is practically uniform and equal to the uniform pressure on the ram. The crank thus becomes simply an agent for regulating and giving a positive stroke to the ram and piston, and the efficiency of the pump is thus considerably increased, as the friction from these parts, together with all cross strains, are reduced to a minimum. It may be added that although two sets of valves and two pistons are used, the valve and piston rods are the same as for a single cylinder. The pumps made with this combination have been thoroughly tested at Messrs. Pearn's works, and the results have, we are informed, been highly satisfactory both as regards efficient working and economy. The special construction of the cylinders and the action of the pump are fully shown in the sectional drawings. In Fig. 1 it may be assumed that the steam has made one cycle, this being necessary to fill the steam chest or receiver, H. High-pressure steam is now admitted into the high-pressure cylinder, A, through the port, I, by the valve, J, and at the same time low-pressure steam is being taken from the receiver, H, through the port, L, by the valve, K, the low-pressure cylinder, E, being open to the atmosphere. Fig. 2 illustrates the further action of the arrangement. On the completion of the down stroke the valves, J and K, take the positions shown, the high-pressure cylinder exhausting through the valve, J, into the receiver, H, from which the low-pressure

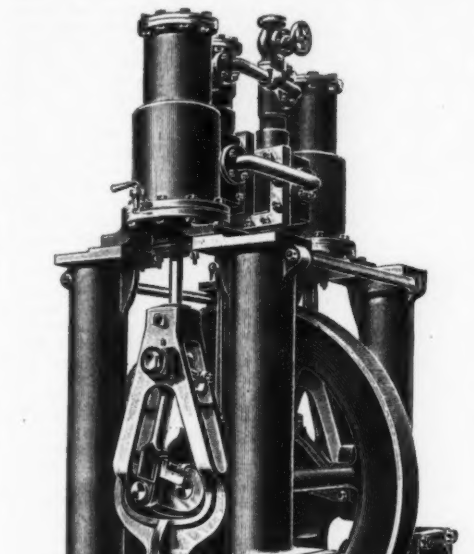


FIG. 3.

cylinder, E, now takes the steam and completes the up-stroke, the annular cylinder, C, being open to the atmosphere. F is the piston-rod, G the pump ram. Fig. 3 gives an elevation of the pump complete.—The Engineer.

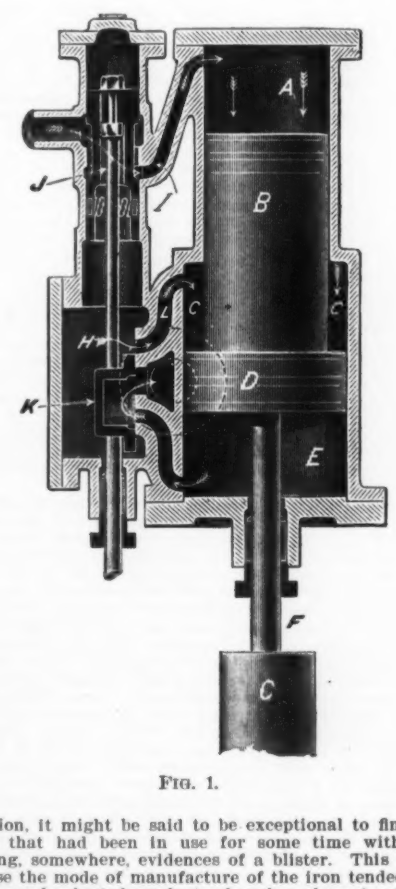


FIG. 1.

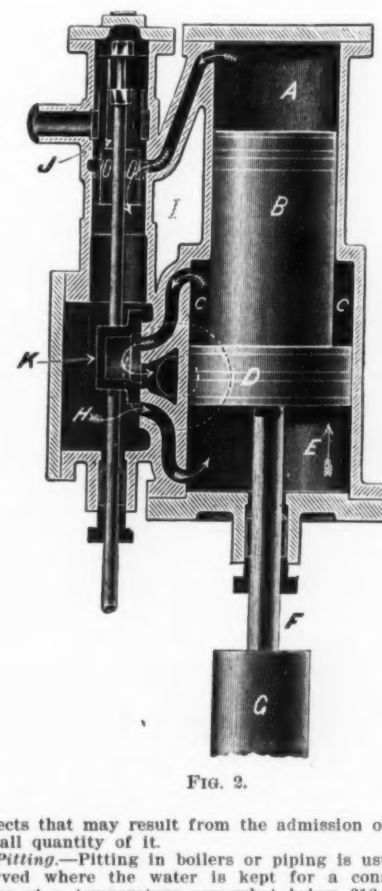


FIG. 2.

A FEW COMMON BOILER TROUBLES.

By R. A. DOUGLASS.

Blisters.—Blisters often appear on the plates of a boiler after the boiler has been in service a short time. Formerly, when iron plate was used in boiler construction, it might be said to be exceptional to find a boiler that had been in use for some time without showing, somewhere, evidences of a blister. This was because the mode of manufacture of the iron tended to produce a laminated product, of such a character that a part of the plate could easily separate from the rest of it. If at some point the various layers of plate were not firmly united to one another, the heat-conducting power of the plate would be materially lessened where the layers were not firmly united, and the result would be that the outer layers would become so much overheated as to soften and bulge outward. Now that steel is used so commonly in the manufacture of boilers, it is rare to find a blistered or laminated plate, although occasionally they do occur. Blisters in most cases are harmless, as they cover only a small area. A blister on the heating surface can be best treated by chipping off the projecting part so as to leave a clean surface of the sound plate exposed to the fire. Unless the blister is very large in extent, it is not wise to cut out the part of the plate in which it occurs. Many a boiler has had its strength materially reduced by having part of the plate cut out in this way and replaced by a single riveted patch, when the other seams of the boiler were double riveted.

Fire-cracks.—These are cracks extending from the edge of the plate to the rivet holes. On the horizontal tubular type of boiler they are found chiefly on the girth seams over the furnace, and in internally fired boilers any of the joints in the fire box may show them. (The inner side of the door is liable to be attacked also.) In most cases fire-cracks do not leak unless they extend past the rivet hole. In this case a half-inch hole should be drilled at the end of the crack, and a stud-bolt screwed into it. This will stop the leakage and prevent a further extension of the crack. Fire-cracks are due to several causes. Thus they are especially likely to appear when the material composing the plate is hard, and does not possess a proper degree of ductility. Again, the plate may have been injured in the construction of the boiler, by the careless use of the drift-pin. Poor management of the fire doors is also responsible to a considerable extent; for when the fire doors are thrown open while a hot fire is burning, so as to allow the cold air from the outside to strike directly against the heated plates, a sudden contraction of the material results, and this is likely to be followed not only by fire-cracks, but also by leakage at the seams in general, or at the tube ends in the rear head. Care should always be taken to avoid all unnecessary admission of cold air against the plates when the boiler is under steam.

Oil.—When heavy lubricating oils, or oils of any sort that leave a considerable residue upon evaporation, find admission to a boiler, it is almost certain that defects will sooner or later make their appearance, and be followed by an extensive bill for repairs. The commonest way for oil to get into a boiler is by being pumped into it together with the drips from a system where exhaust steam is used for heating, and the water of condensation is returned to a receiver. In all systems of this kind an oil separator should be used, and the drip from this should be carried to a sewer. (The writer remembers a case in which the drip from the separator was led into the receiver instead of the sewer, so that the oil passed into the receiver even more directly than it would have done had there been no separator present. The boilers at this plant were nearly ruined in a very short time.) In some cases the exhaust pipe from the engine may be provided with a separator, and yet the receiver may receive the returns from one or more pumps, each of which contributes a certain amount of oil. Oil also gets into the feed-water in connection with condensing engines, when the condenser water taken from the hot well is used as part of the feed. It is impossible to prevent oil from getting into the boiler when feed-water is taken from this source. The importance of excluding oil absolutely from boilers can hardly be understood by those who have not seen the damaging effects that may result from the admission of even a small quantity of it.

Pitting.—Pitting in boilers or piping is usually observed where the water is kept for a considerable time at a temperature somewhat below 212 degrees. The boilers that are mostly affected by this sort of

trouble are those that are used for heating; and in these it is observed chiefly in the fall and spring, when the boilers are used only a part of the time. At such times pitting is likely to be very marked, and it is nothing unusual to see a set of tubes used up in two or three years. In an instance that came under my observation, a new boiler was put into service, for power, in the month of December, being used in connection with five others. Business becoming slack at this factory about the time the new boiler was installed, only three of the available six boilers were needed at any one time. The practice was to use three of the boilers for two weeks, and then to allow these three to stand idle for two weeks, without emptying them. In the following August three of the tubes in the new boiler gave out. Upon examination it was found that the tubes in this boiler were all badly pitted. The three that had given out were replaced with new tubes, and the boiler was thoroughly boiled with soda ash. Two more tubes gave way during this process, and were replaced.

The battery was then put in use again under the same conditions as before, except that every boiler was now emptied when not in service. This occurred eight years ago, and the tubes are still in good condition. The tubes in the older boilers were not affected, as they were covered with a film of scale which protected them. To protect boilers in which pitting takes place the writer would advise that about 10 pounds of lime be slaked and put in each boiler. This will cause the formation of a thin lime scale which will prevent pitting for a time. When this thin protective coating is dissolved away, the operation should be repeated. Of course this treatment is not recommended for a boiler in which there is already a plentiful supply of scale. This would naturally be understood, because it is not in these boilers that pitting occurs. Still, it may be as well to speak of this point explicitly, in order to avoid misunderstanding.—American Electrician.

RECENT STUDIES OF OLD ITALIAN VOLCANOES.

THE abundant and well-preserved extinct volcanoes of Italy have long had a great fascination for students of geology. So many allusions to them are scattered through the literature of the science, and so many accounts of them, more or less brief, have been furnished by those who have visited them, that their general characters and the more important varieties of their rocks are now tolerably familiar. But until lately hardly any of them have been subjected to that minute dissection which modern vulcanology and petrography now demand. The Italian geologists, however, have at last taken up the investigation in considerable detail, and are issuing excellent maps and monographs of different volcanic districts which well deserve the careful attention of all who take an interest in the progress of volcanic geology. To some of the latest of these publications a brief reference may be made.

The Italian Geological Survey has entered upon the study of the volcanoes of Central Italy and their products, and as a commencement has issued a detailed account of that remarkable volcanic center which forms the group of the Alban Hills to the east of Rome. This work has been accomplished by one of the staff, Mr. V. Sabatini, who has long been known for his geological enthusiasm.* It forms a volume of nearly 400 pages, with an excellent map of the region, ten plates of views and petrographical sections, and 79 figures inserted in the text. After a brief introduction devoted to a discussion of some of the theoretical principles involved in the interpretation of volcanic phenomena, the author proceeds to give a sketch of the topography of the region and of the position of its several eruptive vents. He recognizes, as at Vesuvius, the records of two great periods in the volcanic history. The first, one of conspicuous vigor, which built up a large cone that was finally demolished by a stupendous explosion; the second, one of minor force, whereby a cone was formed within the original circuit. Each of these phases has been attended with the production of secondary or adventitious cones, and the author endeavors to trace a series of lines of fissure along which, in his opinion, these cones have been produced. It is to be noted that some of his lines appear to rest merely on the evidence of carbonated or sulphurous springs, and even where they run from cone to cone some effort of imagination is needed to picture the lines of fissure as he gives them. In Southern Italy the geologists are less fanciful in dealing with the unseen substructure of their volcanoes.

The second chapter treats of the various hypotheses which have been proposed in explanation of the origin of the Roman Campagna and the Alban Hills, and especially of the tuffs so widely developed in that region. A detailed description of these tuffs is given; they are classified as lithoid, homogeneous, granular, pumiceous and earthy, and reference is made to the terrestrial flora and fauna enclosed in them. Their plants include many familiar living species. On Monte Celio land shells were found; on Monte Verde the mollusks were of fresh water species; in the tuffs between Nettuno and Astura, Meli has collected a considerable number of marine and estuarine forms, while a large assemblage of bryozoans has been gathered from the volcanic tuffs of Anzio and Nettuno. The succession of the different varieties of tuff is next given as displayed in many sections in and around Rome, and an attempt is made to estimate the cubic contents of the vast sheet of tuff which has been discharged from the Vulcano Laziale.

The third chapter deals with the nature and classification of the Latian lavas. These are grouped into normal leucitites and leucotephrites. The alterations which they have suffered are described, such as the transformation of leucite into felspar. Detailed descriptions are then given, in Chapters IV. and V., of the rocks of each important part of the outer and inner cones of the volcano, and the author, following a practice for which he no doubt can cite high authority, adopts a somewhat complicated and cumbrous system of symbols to express the petrographical characters of each rock. Such a system may be convenient, especially where rapid comparisons of different species and varieties of rocks are desired by a student who has taken the time and labor necessary to understand it and commit it to memory. But life is too short and geological literature is too long for such a task on the part of ordinary readers. It would not have cost much more type to have accompanied the symbols with a brief statement of the composition of the rocks in plain language. The origin and constitution of the craters of Nemi, Castel Gandolfo and Ariccia take up the next three chapters. The author here, as in the rest of the volume, deals less fully with the tectonic than with the petrographical part of his subject. He would have added much to the geological interest of his memoir had he given more ample details of the structure of the great volcano, and presented a clear and vivid outline of the whole succession of volcanic phenomena of which it preserves the record. Perhaps he may intend to deal with these parts of his subject in a subsequent treatise. A useful bibliography is appended to the volume. It is much to be desired, however, that precise references had always been given to the passages in the works of the authors whose names are cited in the text. The continuation of the important research of which Mr. Sabatini gives here the first instalment will be awaited with much interest.

In Southern Italy the investigation of volcanic phenomena is naturally incited by the irresistible attractions of the active volcanoes of that region. The study of the extinct cones and craters, however, has perhaps rather been retarded by the abundant opportunities offered there of witnessing the actual progress of eruptions. Within the last few years the subject of the older volcanoes has been taken up by several observers, who, without the resources of the National Survey to assist them, have nevertheless been successful in bringing much fresh information to light. Two of these geologists—Prof. G. de Lorenzo, of the University of Naples, and Prof. C. Riva, of the University of Pavia—deserve especial commendation for the enthusiasm of their researches. The volume just issued of the transactions of the Royal Academy of Naples contains two detailed memoirs, one by Prof. G. de Lorenzo on the well-known Monte Vulture between Naples and the Adriatic, the other by the two authors conjointly on the seldom-visited crater island of Vivàra between the islands of Ischia and Procida in the Bay of Naples.*

The memoir on Monte Vulture extends to 207 closely printed quarto pages, and is illustrated by numerous figures in the text, as well as a map and a number of excellent plates in photogravure. In an introduction the history of observation regarding this ancient volcano is briefly sketched. The author then proceeds to describe the various sedimentary series through which the volcanic explosions took place. These consist of Trias, Cretaceous, Eocene and Miocene formations, together with Pliocene and Pleistocene deposits, both marine and terrestrial. The stratigraphical relations of these various groups of strata has already been discussed by M. de Lorenzo in a paper on the geology of the Southern Apennines, published in 1896, and they are well displayed in a plate of sections accompanying the present monograph. The incomplete series of Mesozoic formation is shown to have been considerably disturbed before Tertiary time, while the Eocene and Miocene deposits had likewise been plicated and denuded before the Pliocene strata were laid down upon them. In the southern outskirts of the mountain the volcanic pile rests on the younger Tertiary groups, while toward the north it spreads over the area of the Eocene and Miocene "Flysch." The faulted nature of the ground is well shown in some of the illustrations, but the author does not believe that Monte Vulture has had its site determined by the stupendous linear fracture which some theorists have imagined to extend eastward from Vesuvius. He has satisfied himself, by a study of the geological structure of the surrounding country, that no trace of any such dominant dislocation exists.

The various rocks of the volcanic pile are then described in some detail. They are shown to form a numerous and continuous series of varieties between the two extreme limits of trachytoid phonolites, on the one hand, and basalts on the other. The principal types of lava are thus arranged: Hauyne-phonolite, anorthoclase-phonolite, hauyne-tephrite, leuco-hauyne-tephrite, leuco-hauyne-basanite, leucitic basalt, leucitite, nephelinite, hauynophyre. Each of these types is fully described and is illustrated by excellent plates of its microscopic structure. A section is devoted to the characters of the agglomerates by which the lavas are accompanied, and another to the inclusions contained both in the lavas and the fragmental materials, some of which were doubtless derived from the underlying sedimentary platform; others probably represent portions of the subterranean magma which have acquired a granitoid structure at a great depth, while in some cases their origin is doubtful.

Having described the materials of the volcanic pile, the author next furnishes an account of the way in which they have been built up into the huge mass of Monte Vulture. In a long and interesting section of the paper the structure and probable history of the mountain are discussed, and the position of its various rocks and some of the successive phases in the evolution of the topography are explained in diagrams inserted in the text. The next division treats of the lakes which, partly in consequence of the volcanic disturbances, were formed in some number and of considerable size during Pleistocene time. This subject had already been treated by M. de Lorenzo in a separate memoir (Atti Accad. Scien. Napoli, 1898), in which he has shown that Southern Italy in Quaternary time was dotted over with large and small basins of fresh water. Whether formed in consequence of changes in the topography produced by the volcanic eruptions or existing before these eruptions began, the lakes around Monte Vulture were more or less filled up with limno-volcanic tuffs containing fresh water shells and likewise remains of *Elephas antiquus, Hippopotamus major, Ursus spelaeus, Felis spelaea, Hyena spelaea* and *Cervus elephas.*

In a final section the author states what he believes to be the bearing of the history of Monte Vulture on theoretical questions of volcanism. He insists on the total independence of the eruptions of this center, which he thinks has no direct communication with those of any other. He can find no trace of the great connecting fissures which have been supposed to link together all the old and modern volcanoes of Southern Italy. He regards the eruptions of this center as having begun long after the great orogenic movements that gave rise to the Apennine chain, and at a time when perennial snows and glaciers still lingered on the surrounding heights. Phonolithic lavas first made their appearance, followed by tephrites, basanites and basalts, which form the great mass of the mountain. Two peripheral vents can be distinguished, one anterior, the other posterior, to the formation of the great central cone. The last stupendous manifestation of volcanic energy seems to have been the explosion which blew out the great crater in which the two crater lakes of Monticchio now lie.

M. de Lorenzo acknowledges the important services rendered to him by his friend, Prof. Riva, the young and accomplished mineralogist of Pavia whose petrographical assistance and photographic skill were freely given in the preparation of this important monograph. The other memoir above cited is a joint production of the two observers. It is entitled "Il Cratere di Vivàra nelle Isole Flegree," and forms No. 8 in the same volume of the Transactions of the Naples Academy. It begins with an interesting historical introduction, and then at once enters on a discussion of the rocks of which the remarkable island is composed. These consist entirely of fragmentary materials which have been heaped up around a crater, as in the other volcanic cones of the Campi Phlegræi. A careful account is first given of the coarse breccias or agglomerates, which include blocks of trachytic obsidian, sanidinites with quartz and catoforite, anorthoclase-trachytes with ægirine, augitic trachytes, mica-trachytes, andesitic trachytes, basalts, trachydolerites, rocks of dioritic type (monzonites) and other varieties. Full petrographical descriptions of these rocks, together with micro-photographs of their internal structure, are given. The varieties of pumice, lapilli and tuff are likewise detailed. It is shown that the eruptions of Vivàra, unlike those of the neighboring region, did not consist solely of trachytic material, but discharged an admixture of a trachytic and a basaltic magma, so as to have heaped up a rich assortment of the most remarkable rocks, beginning with a quartziferous sanidinite and passing through various trachytic types to normal olivine-basalt. The relations of these rocks to the other similar materials in the Phlegræan region are next discussed, and the authors then pass to the structure of the island, which they show to consist of successive sheets or banks of ejected fragmentary volcanic material without any accompanying lavas, and disposed in the usual divergent arrangement, the portions on the outer surface of the cone dipping steeply outward into the sea, while those on the inside are inclined toward the center of the crater. Vivàra rises out of the Mediterranean as a truncated cone which attains a height of 109 meters and a diameter across its upper rim of about 900 meters. The eastern half of the cone has been broken down and the sea now fills the circular crater. The waves and rains have cut many sections of the rocks, and thus the structure of the old volcano has been admirably dissected. All students of vulcanology will welcome these memoirs and hope that they may be regarded as the precursors of a long series in which the volcanic history of Southern Italy will be thoroughly elucidated.—Arch. Geikie, in Nature.

COAL IN THE ARCTIC REGIONS.

To obtain coal in the Arctic regions seems almost a paradox, but the Berlin correspondent of the London Standard informs its readers that good seams of coal have been found on the western side of Spitzbergen, and are to be worked on the most approved business principles. That carboniferous rocks existed in the island has been known for some time, but during the last summer experts were dispatched from Norway to ascertain whether the mineral was sufficiently abundant and accessible to be worth working. Their reports were most favorable. Good furnace coal has been found in Green Harbor, on the south side of the entrance of Ice Fjord, which pierces so deeply into the western flank of the principal island that the latter is almost cut up into three parts by the meeting of inlets from opposite coasts.

At another place in the same fjord three of the seams are from six to nine feet thick, and as they are above sea level must crop out at the surface. The larger and eastern part of Spitzbergen is more or less a plateau, and the strata are horizontal, ranging from the period anterior to the carboniferous to that in which our chalk was deposited. The western part is mountainous, and consists of older crystalline rocks, but uplifted parts of these sedimentary strata here and there rest upon them, as is the case where these seams have been discovered. In such circumstances, the fields are likely to be limited in extent, and the seams may be tilted at high angles, or broken up by faults. Still, as the coal can be worked by adits its accessibility and the consequent economy in labor will be a compensation. These discoveries make it highly probable that larger, and perhaps richer, fields exist in the eastern part of the island, which, however, will be less easily reached.

The effect, direct or indirect, of the Gulf Stream opens the west coast of Spitzbergen in summer, but the other is more difficult of approach. It is stated that even in the sheltered Ice Fjord the coal cannot be shipped directly from the land, and the piers must be removed before winter, during parts of which work will have to be suspended. But when the coal has been followed for some little distance from the surface, there will be nothing to prevent the miners from going on even in December. The ground, no doubt, is permanently frozen for a considerable depth, but the temperature will rise steadily as the distance from the

* I vulcani dell' Italia Centrale e i loro Prodotti. Parte Prima—Vulcano Laziale, di V. Sabatini. Roma, 1900. (R. Ufficio Geologico. Memorie Descrittive della Carta Geologica d' Italia, vol x.) This volume, the author informs us, is based on the work of 112 days in the field and the examination of 400 microscopic slides of rocks. The volcanic center here referred to under the name of "Vulcano Laziale" comprises the Monti Laziali and the Monti Albani and their surroundings.

* "Atti della Reale Accademia delle Scienze Fisische e Matematiche di Napoli," second series, vol. x, 1901.

surface increases, and will be uniform. After a while the mine will be more comfortable than any house. As it is, the party will winter in the island from the first, and the longer they can work the more healthy they will be. But Spitzbergen may not be the only Arctic island in which coal occurs, though perhaps it is the most favorable for commercial purposes. The fuel may be found in Franz Josef Land; beds full of fossil plants occur near Eira Harbor—of later date, indeed, but in rocks which elsewhere occasionally produce coal. From Nova Zembla Colonel Fielden brought back specimens of limestones which experts assigned to an age very near that of our English coal beds, and other localities could readily be named. But these masses of fossil vegetable matter indicate curious changes in the climate. Nowadays nothing bigger than the stunted Polar willow grows in Spitzbergen. Even in the extreme north of Norway the hardy birch is dwarfed. Yet these ancient plants formerly almost rivaled forest trees, and the change was late in coming. A temperate climate existed as far north as the seventieth parallel, and in Greenland beds of brown coal were formed even in the Tertiary era. At that time the plane, the magnolia and the vine flourished in the latitude of Disco Bay.

PROF. ADAMS' LECTURES ON THE LUNAR THEORY.

By P. H. COWELL.

PROBABLY few courses of lectures have enjoyed as great a reputation as those which Prof. Sampson, after including them among the collected papers of Prof. Adams, has now published in book form. The lectures deal with the most interesting of all problems of applied mathematics, and at the time of their delivery they formed the only adequate attempt to present the subject to a student in a form so that, while a comprehensive view of the whole subject is achieved, numerical labor is as far as possible avoided. As Prof. Sampson says, several treatises exist that are intended to form the basis of tables in which completeness is the first object and manner of presentation the secondary. During the period 1860-1889, when Prof. Adams was lecturing on the subject, there were in existence elementary theories, of which Prof. Sampson truly says that they leave off when the difficulties of the subject begin—that is to say, the various cases of slow convergence have been exposed and not dealt with. To present the same idea in slightly different language: It is conceivable that a computer might repeat the whole of the calculations of a lunar theorist, and verify his numerical accuracy (or detect his errors, as the case may be), and at the end of his work, which would probably take quite ten years, he might not have a clear geometrical conception of what he had been doing. Again, one of the elementary treatises referred to might awaken in a reader a faint glimmering of the nature of the subject, but it would hardly place him in a position to carry on the calculations for himself to the accuracy required for forming tables. Adams to a great extent achieved success in a middle course. He divided and got the mastery of his subject. He left on one side those higher approximations that involve merely labor in computing, and illustrate no principle, but he pushed the lower approximations to a high degree of accuracy, and not merely showed how to obtain, but actually did obtain numerical values for the principal parts of the motions of the node and apse and the co-efficients of the principal inequalities. The great value of his lectures may be illustrated by the fact that when ill-health compelled Adams to cease lecturing shortly before his death, notes of his lectures were borrowed and copied by the younger generation. Prof. Sampson was fortunate to be among the last that attended the course; the present writer was among the first to make a copy.

The lectures were last delivered twelve years ago, and were constantly revised during the whole period in which they were delivered. And yet they are already, and have for some time been, to a great extent out of date. The last two chapters of Adams' lectures deal with Dr. Hill's methods. These methods have since been developed by Prof. Brown, and made the basis of lectures in Cambridge by Prof. G. H. Darwin. The concluding portion of this notice will be to attempt to explain the points of superiority of Hill's method over all that preceded it.

Any co-ordinate of the moon—that is to say, its longitude or its latitude, or its radius vector, or the projection of its radius vector in any direction—may be developed in a series of periodic terms, whose arguments are the sums of any integral positive or negative multiples of four fundamental angles that increase uniformly with the time and at rates that are incommensurable. The immense complexity of the problem may be conceived by imagining four piles of coins of incommensurable value. One pile, we may suppose, consists of sovereigns, and, in addition, "negative" sovereigns, that is to say, acknowledgments of debt to the extent of a sovereign; the other piles are to consist of francs, marks and krönes with corresponding "negative" coins, or acknowledgments of debt. Then for every sum of money that can be made up from these coins, there is a periodic term in the lunar coordinate, and if not more than seven to twelve coins are used to make up the sum, then the co-efficient of the corresponding term in the lunar theory is important enough to be calculated. In addition a very great number of these co-efficients are large and correspondingly difficult to calculate, for the same reason that a very slight muscular effort, constantly repeated at regular intervals, will set a swing into violent oscillation, or that a ship that remains moderately steady in some seas will roll violently in others when the interval between one wave and the next happens to be of a certain length.

Now if this illustration has given any idea of the gigantic nature of the task, it will be clear that it will be a great convenience if the theory is such that the terms can be calculated in groups of a small number at a time, first one group and then another group, just as Nature builds up a living organism by "epigenesis," or the adding of one cell to another cell. When this can be done, another stage can be added at any time, should it be considered convenient to do so. When it is not the case, not only is the labor much increased, but it is nearly impossible to extend the work to approximations higher than those at which the original computer left it. This criterion is a condemnation of Delaunay's theory, which, while it is in many ways the most elegant from the mathematician's point of view, has probably proved the most laborious of all in its computations, and has nevertheless not been pushed to such accuracy as might have been desired. But in this respect both the theory adopted by Adams and that propounded by Hill leave nothing to be desired.

Both Adams and Brown (who is working out Hill's theory) divide the terms into groups. Now there is only one way of dividing into groups, and the first group of terms constitutes what is called the variation, which is an inequality in the moon's motion that goes through its period in half a synodic month. Now Adams and all the theorists before Hill start by pointing out, that owing to its immense distance the sun's influence is very slight, and if it could be neglected altogether the moon's orbit would be an ellipse. Then it is found that although the sun's influence is slight, yet in some respects it is cumulative and not periodic, and hence we have a rotating ellipse introduced to our notice which, doubtless, is a very convenient geometrical representation of the moon's path, but it is hardly a good "intermediate orbit" or first approximation for a dynamical calculation, since it does not represent an orbit that would result from an approximation to the actual forces that govern the path of the moon. Now Hill takes the first terms that are calculated—the variation—and interprets them dynamically. These terms, and these terms only, represent a possible path for the moon that could correspond to the actual case of Nature, with one modification; the sun must be supposed to be at infinite distance, while retaining influence enough upon the earth-moon system to maintain the length of the year at its present value. The next group of terms to be selected for calculation (for although the grouping is determinate, there is a little choice as to the order in which the groups are to be taken) may modify the orbit (by adding what are known as the parallactic inequality, because it only exists in consequence of the sun's parallax not being zero, and the annual equation due to the ellipticity of the earth's orbit round the sun) into an orbit that the moon might pursue, only it happens not to do so. And then the rest of the work consists in this only: The moon is considered to oscillate in two ways about the above-mentioned orbit that it might pursue: in the first place it does not remain in the plane of the ecliptic but oscillates from side to side of it; in the second place it keeps crossing and recrossing the orbit it might pursue. The size of these oscillations must be determined by observation, for, as has been pointed out, they need not exist at all, and their size is subject to no conditions, and might have been anything including their actual values or zero. Moreover, the periods of these oscillations must be determined by calculation, and the lunar theory is then complete.

Calculation shows that the periods of these oscillations are neither of them exactly a month; and, therefore, to confine our attention to the oscillation across the plane of the ecliptic, the node or point of crossing is not the same in each revolution, or, in other words, the node revolves. This is not contrary to expectation; the suprising thing would have been if the period of oscillation had turned out to be exactly a month; and it leads to no inconvenience, such as in the older theories, when it compelled the introduction of rotating ellipses with no dynamical interpretation.

We conclude with another example of the advantage of treating the eccentricity and inclination as oscillations. It is well known that as long as the arc of vibration of a pendulum is very small, the period of its oscillation remains constant, but when the arc of oscillation is increased, the period of its oscillation is altered by terms depending on the square and higher even powers of the arc of vibration. Now this is one of the simplest dynamical problems to work out, just as the lunar theory is one of the most difficult; but the analogy holds exactly; for the principal term in the motion of the moon's node (or apse) is independent of the size of the oscillations—that is to say, the moon's node would still revolve in about nineteen years even if the eccentricity or inclination were double or half what they are; but the smaller terms in the series that give the motions of the apse and node contain squares and higher even powers of the amplitudes of the two oscillations.—Knowledge.

THE LARGEST KNOWN DINOSAUR.

THE Field Columbian Museum paleontological expedition of the past summer was fortunate in securing a number of dinosaur bones belonging to an animal unique both in size and in proportions. These bones consist of a femur, humerus, a coracoid, the sacrum, an ilium, a series of seven presacral vertebræ, two caudal vertebræ, and a number of ribs. Part of this collection has been placed on exhibition and the remainder will follow from time to time as the work of preparation proceeds.

The most striking characteristic of this animal, so far developed, is the relative length of the front and hind legs. While the humerus of *Brontosaurus excelsus* Marsh is a little more than two-thirds as long as the femur, the humerus of the individual in question is decidedly the longer bone of the two.

The femur is a stout bone with expanded condyles and a head not constricted from the shaft. The specimen is somewhat crushed antero-posteriorly, but otherwise in a fine state of preservation. Its greatest length parallel to the axis of the shaft is 80 inches (2.003 m.), which is 6 inches longer than the femur of Marsh's *Atlantosaurus*. The humerus is broad at the proximal end, but unusually slender in the shaft. It has suffered somewhat from weathering, so that the entire surface of the distal end has flaked away, leaving a firm chalcedony core. In this condition its length is equal to that of the femur; with the articular end complete it would probably exceed it by two or more inches. Its present length is greater by 23 inches than the longest humerus hitherto known to science.

The coracoid is broad and straight at the scapular articulation, but less massive than that of *Brontosaurus*. The sacrum is made up of four co-ossified vertebræ, having small lateral cavities in the centra. A complete rib, presumably from about the sixth presacral vertebræ, measures more than 9 feet in length. Some of the thoracic ribs have a secondary tubercle, and also a foramen leading to a cavity in the shaft. However, these may not prove to be constant characteristics.

The similarity of the femur to that of *Atlantosaurus*, together with the presence of but four vertebræ in the sacrum, suggests that this animal may belong to that group. The writer does not feel justified in creating a new genus until the material shall have been sufficiently worked out to make an accurate determination possible. However, the evidence at hand is sufficient to show that we have here to do with an animal which differs radically from any well-known dinosaur. The extraordinary length of the humerus, together with the size of the coracoid, suggests an animal whose shoulders would rise high above the pelvic region, giving the body something of a giraffe-like proportion. The relatively smaller size of the anterior caudal vertebræ indicates a lesser development of the tail than is common among the sauropod dinosaurs. Along with these proportions we may well expect to find a correspondingly shorter neck and, perhaps, an animal fitted for arboreal food habits. Such a short-necked type was long since suggested by Marsh in his *Apatosaurus laticollis*.

In a future publication of the Field Columbian Museum a complete description of this most interesting dinosaur will be given.—Elmer S. Riggs, in Science.

EFFECT OF IRON SULPHATE ON VEGETATION.

IRON sulphate in solution has been long employed for the treatment of certain diseases of plants, especially chlorosis. My experiments have been made on garden vegetable seeds.

In June, year before last, I planted some kidney beans in a bed of about 40 square meters. The season was dry, the crop poor, and I tried again with similar results.

Examination of some of the beans taken at the moment of germination showed that the result was chiefly due to the ravages of myriapods, snails and worms. Something had to be done to prevent this injury to young plants, and the idea occurred to me to adopt a plan similar to the sulphuration of wheat. But instead of copper sulphate, too energetic and too dangerous to manipulate, I employed a 1 per cent solution of iron sulphate (10 grammes per liter of water), which is easy to prepare and convenient to use.

A part of the beans were soaked for twenty minutes in the solution and immediately planted in six rows in such an order that a row of beans not sulphated came between two sulphated rows, while the last three rows were planted exclusively with beans not sulphated.

The result exceeded my expectations. The crop was in excellent condition, with the exception of the last three rows. For a long time it was easy to distinguish the sulphated rows from the others, their height being greater by several centimeters, and their dark green color contrasting with the light green of their neighbors.

Still I was struck by one fact: The seeds planted between the sulphated rows had sprouted regularly and had grown well, while the last three rows had produced only sparse and feeble plants. It was evident that those intercalated had been protected by their neighbors, while the others not treated had succumbed to attacks without being able to defend themselves.

To make the demonstration complete, the experiment was repeated with modifications, because it might be assumed that the soaking alone was the cause of the difference.

This was done with different seeds. Three rows of sulphated seeds were planted in the middle of a bed. The improvement was constantly recognized, both in the size and color of the plants.

One bed planted with Algerian butter beans was divided into three parts; the first, with sulphated beans, appeared a day earlier than the others and attained an average height of 1.90 meters; the second, planted with beans soaked only in water, attained a height of 1 meter; the third, planted with dry seeds, had a poor growth and did not exceed 0.40 meter. The manure and cultivation for the three parts were identical and the beans planted uniformly by sevens, so that there was no room for doubt. The vegetation and the yield of those soaked in iron sulphate were such as scarcely to admit of comparison.

Besides the difference in size and color, the roots of the sulphated plants had numerous knots, large and often grouped. On the roots of those not sulphated these were small and rare.

This fact inclines me to believe that the sulphated plants assimilate nitrogen from the air much more readily, which explains their difference in size.

The experiment with peas has been almost as conclusive. One bed, about 10 meters square, was divided into two equal parts and sown at the beginning of February. One of these parts received sulphated peas; the other, peas not sulphated.

Germination occurred earlier, more regularly and more quickly in the first portion. Some stalks pulled up on February 22 showed: (1) That the seed-lobes were thicker and more vigorous; (2) that the stalks were developed in length and size; (3) that the outside of the sulphated peas was dull gray in color, those not sulphated remaining green; (4) that the sulphated plants were intact, although the others showed traces of attacks by insects or snails.

Up to the time of flowering, the difference in height between the two parts of the bed was so great that it could be perceived at a distance of 50 meters. After flowering it was still easy to distinguish a difference in the thickness of the foliage.

The difference in yield was about 0.500 kg. of shelled peas, say 100 grammes, to the square meter, or an increase of about 10 per cent.

The experiment with turnip seed was also very conclusive. For several years my sowings of turnip seed had been devoured by the turnip-beetles. The past year, by sulphuration, I secured very good results. By transplanting, also, I have obtained some fine roots.

Finally, I have experimented with spinach, salsify, cabbages, carrots, leeks, meaux, chicory. For salsify

alone the experiment has been rather unfavorable. The sulphated spinach and cabbage appeared a day earlier than the others. The sulphated salads were very beautiful.

The experiment will bear repeating with the small seeds, varying the proportion of sulphates and the time of soaking. For the small seeds I would advise the substitution of sprinkling for soaking, after the seeds have been sown.

The sulphuration of the seeds of cabbages, turnips, radishes, salads, and of beans and peas, should be made with a proportion of 10 grammes of sulphate for 1 liter of water, soaking for about a quarter of an hour. The expense is trifling.

The result will always be an earlier and more regular appearance and a greater yield.—From the French of M. E. Henriot in La Nature.

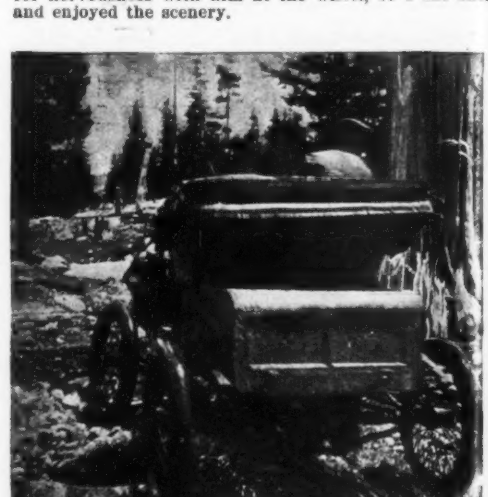
AUTOMOBILING IN THE WEST.

By Charles B. Shanks.

Covering the North American continent from the Pacific coast to the Atlantic Ocean in an automobile has been attempted by Alexander Winton, president of The Winton Motor Carriage Company, of Cleveland.

TYPE OF ROADS FOUND IN THE HIGH SIERRAS.

ONE MUST GET DEEP INTO ADOBE MUD TO FULLY APPRECIATE IT.



FIGHTING THROUGH THE MOUNTAINS.

That the expedition failed is no fault of the machine Mr. Winton used, nor was it due to absence of grit or determination on the part of the operator. Neither was the failure due to roads. The utter absence of roads was the direct and only cause.

Having been with Mr. Winton on this trip, I saw and experienced things the like of which automobile drivers in every civilized portion of the North American continent know not of, nor can an active imagination be brought to picture the terrible abuse the machine had to take, or the hardships its riders endured in forcing and fighting the way from San Francisco to that point in Nevada where the project was abandoned —where Mr. Winton had forced upon him the positive conviction that to put an automobile across the sand hills of the Nevada desert was an utter impossibility under existing conditions.

Rock roads and deep snow in the high Sierras were encountered and mastered, streams were forded and washouts passed, adobe mud into which the machine sank deep and became tightly imbedded failed to change the plucky operator's mind about crowding the motor eastward toward the hoped for goal.

It was the soft, shifting, bottomless, rolling sand—not so bad to look upon from car windows, but terrible when actually encountered—that caused the abandonment of the enterprise and resulted in the announcement by wire to eastern newspaper connections that the trip was "off."

To those who are interested in knowing what was met and mastered during the days we were out from San Francisco; to those who wish to learn some facts about automobiling in a section of this country where all kinds of climate and every condition of road may be encountered in a single day, the experiences of the short trip will satisfy.

Our expedition left the government building in San Francisco and started across the bay for Oakland at 7:15 A. M., Monday, May 20. Left ferry foot of Broadway and got on road at 8 A. M. Turned off Broadway at San Pablo Avenue heading for Port Costa, distance thirty-two miles, hoping to reach there in time to catch the Sacramento River ferry to cross with Southern Pacific Express No. 4, which left Oakland at 8:01 with schedule to reach Port Costa at 9:15 A. M.

Instead of running the thirty-two miles we clipped off forty-four between Oakland and Port Costa as a consequence of mistaking road to San Pablo and going around by way of Martinez. Reached Port Costa too late for the No. 4 trip and had to wait until 11:17 A. M., when the transcontinental express (The Overland Limited) was ferried over.

All morning the sky, which during the three weeks preceding had been clear and bright, was heavy with clouds. Before the opposite bank of the Sacramento was touched the clouds opened. And what an opening it was. Adobe roads when dry and hard hold out opportunities for good going, but when the sponge-like soil is soaked with moisture, when your wheels cut in, spin around, slip and slide from the course and suddenly your machine is off the road and into the swamp ditch—buried to the axles in the soft "doby"—then the fun begins.

Pull out block and tackle, wade around in the mud, get soaked to the skin and chilled from the effects of the deluge, make fastenings to the fence or telephone post and pull. Pull hard, dig your heels into the mud and exert every effort at command. The machine moves, your feet slip and down in the mud you go full length. Repeat the dose and continue the operation until the machine is free from the ditch and again upon the road.

Tie ropes around the tires to prevent slipping. It may help some, but the measure is not entirely effective, for down in the bog you find yourself soon again and once more the block and tackle are brought into play. Slow work—not discouraging in the least, but a bit disagreeable, considering that it is the first day out and you are anxious to make a clever initial run.

After twelve hours' severe experience and the rain still pouring down, halt is made abreast of a lane leading to a ranchman's home. This ranchman is A. W. Butler. He came down to the road and replying to interrogations tells you that to Rio Vista, nine miles ahead, the road is particularly bad because of plowing and grading. Arrangements are made for our staying all night with him. The machine is run in his barn, we eat supper with intense relish, go to bed and get up early to find more rain, but a breaking up of the clouds with prospect of sunshine later.

Got upon the road 7:40 A. M. Reached Rio Vista and two miles further on to "Old River" at 8:40. Go east on the levee road, which is of adobe formation with steep descending banks on both sides. On the left side is the river, the opposite bank runs down to a thicket, beyond which are orchards. Slide off the treacherous road on either side and nothing short of a derrick and wrecking crew could serve to a practical and satisfactory end.

A few miles from the ferry a tree had fallen across the road. Mr. Winton used the ax to splendid advantage and after some delay the road was cleared and we were going ahead once more. Reached Sacramento at 1:15 P. M., but delayed in California's capital city just long enough to take on five gallons of gasoline. On we went toward the Sierras, passing through Roseville, Rocklin, Loomis, Penry, New Castle, Auburn, Colfax, Cape Horn Mills and when darkness was fast approaching halt was made in the little gold mining town of Gold Run.

From Auburn the climb commenced, and when Colfax was reached and passed Mr. Winton was busy with his skillful knowledge in crowding the machine up steep mountain grades, along dangerous shelf roads from which one might look deep into canons and listen to the distant roaring of rushing waters below.

Ordinarily there would be great danger in speed under such conditions—and there may have been risk to life and limb at the time, but I knew Mr. Winton, I knew him for his skill and that there was no call for nervousness with him at the wheel, so I sat back and enjoyed the scenery.

Reached Gold Run at 7:40 P. M., just in time to escape darkness and avoid going into camp on the mountain side. On such roads, or, rather, surrounded as we were by canons, operation in the dark could not be regarded as safe. Our run that day was 123 miles.

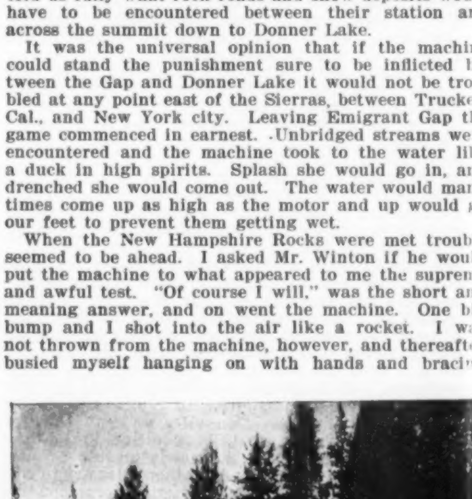
Next morning, May 22, at 6:45 o'clock, the ascent was recommenced. Up and up we went, winding around and turning in many directions—but always up. From Gold Run we passed along through Dutch Flat, Towle, Blue Canon, Emigrant Gap, Cisco and on to Cascade. Roads became particularly rugged after leaving Gold Run, and when we reached Emigrant Gap the few inhabitants who make that their home told us fully what rock roads and snow deposits would have to be encountered between their station and across the summit down to Donner Lake.

It was the universal opinion that if the machine could stand the punishment sure to be inflicted between the Gap and Donner Lake it would not be troubled at any point east of the Sierras, between Truckee, Cal., and New York city. Leaving Emigrant Gap the game commenced in earnest. Unbridged streams were encountered and the machine took to the water like a duck in high spirits. Splash she would go in, and drenched she would come out. The water would many times come up as high as the motor and up would go our feet to prevent them getting wet.

When the New Hampshire Rocks were met trouble seemed to be ahead. I asked Mr. Winton if he would put the machine to what appeared to me the supreme and awful test. "Of course I will," was the short and meaning answer, and on went the machine. One big bump and I shot into the air like a rocket. I was not thrown from the machine, however, and thereafter busied myself hanging on with hands and bracing

ANOTHER SPECIMEN OF ROADWAY (?) UP AMONG THE CLOUDS.

A HALT FOR "DINNER" IN THE DESERT



"NEW HAMPSHIRE ROCKS" IN THE HIGH SIERRAS.

with feet. At every turn and twist in the road the rocks grew larger, and I wondered if anything mechanical could stand the terrible punishment.

The motor never flinched, its power never lagged, it pulled us through those rocks and up the stiff grades. Emigrants westward bound in the early days would never trust horses or mules to convey their wagons safely to the bottom of one particularly stiff and rugged grade which Mr. Winton caused the motor to ascend. Those early day pathfinders would tie a rope to the rear axle of the wagon, take a turn around a tree and lower it gently.

We at last got through the New Hampshire Rocks and began calculating what would be our fate in the snow immediately to be encountered. The Cascade Creek, swollen by the melting mountain snows to river proportions, caused a halt about one-half mile west from the commencement of what was expected to be bothersome snow.

The water in the stream was clear and sparkling, the current swift, and the bottom filled with huge sharp rocks. Mr. Winton pulled in the lever, the machine forged ahead. Splash and bump, bump and splash. Front wheels struck something big and hard, they went up in the air and when coming down, almost at the east bank, the right front wheel with a wet tire struck a wet slanting rock. The wheel was hard put, something must give way—and it did. The front axle on the right side sustained an injury, and after a lurch ahead the machine came to a sudden standstill.

Mr. Winton sent me to hunt a telegraph station. Walked east for about a mile until I could look up the mountain side and see the railroad snow sheds with some sort of a station in an opening. I climbed up through the snow, over fallen trees, broke passage through tangled bushes and finally came upon a surprised operator, who asked what the trouble was. It was a little telegraph station for railroad service only, but the dispatcher took my messages and repeated them to the Gap, from which point they were sent, one to the Winton factory at Cleveland, asking for duplicate of part damaged, and another to L. S. Keeley, of Emigrant Gap, to come for us and our effects and take us back to the Gap, where we would wait for the repair parts. The machine was left alone in the mountain wilderness.

Arrived at the Gap and Mr. Winton soon developed uneasiness because of the enforced delay in the trip. Next morning he announced his intention of making a temporary repair and working ahead slowly through the snow.

On the following morning (May 24) at 7 o'clock the repair had been completed. When darkness enveloped us that evening the machine had covered seventeen miles. And such a day of battle. When it was over we had reached and passed the summit of the high Sierras, the machine was hard and fast in a snow bank at the bottom of "Tunnel No. 6 hill," a treacherous descent, along which there was great peril every moment.

We walked back to Summit Station and stayed at the hotel that night. Next morning, aided by some kindly disposed railroad men who could handle shovels most effectively, the machine was dislodged.

Since the day in the snow banks I have called it to Mr. Winton's mind. He says that the frightful experiences of that day, the abuse and hardship to which the machine was subjected, stay in his mind like the remembrance of an ugly nightmare. During the entire day, working up there among the clouds, we were cold and drenched. When it did not rain it snowed or hailed.

On the 25th, after getting free from the snow bank and passing through a number of smaller deposits, we got to Truckee, where we took on fuel and went on to Hobart Mills, a delightful lumber town, where Mr. Winton decided we would stay during the following day, Sunday, and dry our clothes. Reached Hobart Mills in a terrific downpour.

The officials of the Sierra Nevada Wood and Lumber Company (the "company" owns the town and all there is in it) were particularly generous in bestowing upon us many courtesies and making the time we spent with them in Hobart Mills that of delightful remembrance.

Monday, May 27, started 6 A. M. from Hobart Mills, and that afternoon, toward evening, reached Wadsworth, Nev., the western gate to one of the worst patches of desert sand in that section. That day was another of rain. The early morning hours were bright, but when Reno, Nev., was left behind the skies changed from blue to white, then to a dark color and the clouds that had so quickly formed opened and spilled their contents about and upon us.

Reached Wadsworth splashed and covered with mud, wet through and hungry. Spent night at Wadsworth. Residents warned Mr. Winton about sand, more especially the sand hill just east of the town. Next morning we took on stock of rations and drinking water. That "sand hill," or rather the remembrance of it and the balance of our trip to Desert Station that day, are like the remembrance of another beastly nightmare.

All during the afternoon it rained and the wind blew a gale, but the temperature was high and we did not mind. Had it not been for the rain and its cooling

QUICK-SAND IN NEVADA DESERT, WHERE MACHINE WOULD SINK TO THE AXLES, RENDERING PROGRESS IMPOSSIBLE.

effect there on the sand and sage brush desert, I doubt whether we could have stood it.

The storm that day caused us to speculate largely as to whether some of the many bolts of lightning hitting close around us would not strike the machine, demolish it completely and incidentally put the operator and passenger out of business.

But a kind providence was with us during the storm and the lightning kept off. Getting up the Wadsworth sand hill we cut sage brush and kept piling it up in front of all four wheels to give them something to hold to and prevent slipping and burrowing in the soft sand until the machine was buried to the axles and it became necessary to use block, tackle and shovels to pull up to the surface. Got to the top at last, but found no improvement in sand conditions. It was the hardest kind of work to make the slightest progress, but at 5:45 in the evening halted at Desert Station, a place inhabited by D. H. Gates, section boss, his wife, Train Dispatcher Howard (his office, cook house, etc., were all combined in a box car which had been set out on a short siding), and a dozen Japanese section hands.

Passed the night comfortably, and when the road was taken next morning (May 29) at 6 o'clock the sun was shining and Mr. Gates predicted no rain for the day.

We found the roads somewhat improved and on and on we went through that vast country of magnificent distances. We were in the country where rattlesnakes were thickest, near Pyramid Rock, of which one writer says: "This rock pyramid is alleged to be the home of rattlesnakes so numerous as to defy extermination."

When out of the machine and walking around bunches of sage brush care was exercised in keeping out of striking range of these venomous reptiles. Mr. Winton has some tail end rattles as trophies, but I was not so anxious to get close enough to kill the snakes and cut off their tails.

That day we plunged through four unbridged streams and in one place where a bad washout had occurred it became necessary for us to build a bridge before the machine would "take the ditch." We lugged railroad ties—many ties from a pile close to the railroad tracks some distance away. And they were heavier than five-pound boxes of chocolate, but we finally got enough and bumped the machine through and on its way.

Mill City was reached shortly before 5 o'clock. The Southern Pacific agent there said we could never get to Winnemucca (thirty miles to the east) that night because of the sand hills; the quicksand would bury us, he said. Another man who came up discussed the sand proposition with Mr. Winton and told him that there would be only one way in which "that there thing" could get through this thirty miles' stretch of quicksand. "How?" asked Mr. Winton. "Load her on a flat car and be pulled to Winnemucca."

"Not on your life," retorted the plucky automobilist; into the carriage I jumped, he pulled the lever and off we went. The course led up a hill, but there was enough bottom to the sand to give the wheels a purchase and from the hill summit we forged down into the valley where the country was comparatively level. Nothing in sight but sage brush and sand, sand and sage brush.

Two miles of it were covered. Progress was slow, the sand became deeper and deeper as we progressed. At last the carriage stopped, the driving wheels sped on and cut deep into the bottomless sand. We used block and tackle, got the machine from its hole and tried again. Same result. Tied more ropes around wheels with the hope that the corrugation would give them sufficient purchase in the sand. Result: Wheels cut deeper in less time than before.

It was a condition never encountered by an automobilist in the history of the industry. We were in soft, shifting quicksand where power counted as nothing. We were face to face with a condition the like of which cannot be imagined—one must be in it, fight with it, be conquered by it, before a full and complete realization of what it actually is will dawn upon the mind.

Mr. Winton said to me: "Do you know what we are up against here? I told the Plain Dealer I would put this enterprise through if it were possible. Right here we are met by the impossible. Under present conditions no automobile can go through this quicksand." I suggested loading the machine and sending it by freight to Winnemucca. "No, sir," he flashed back emphatically. "If we can't do it on our own power this expedition ends right here, and I go back with a knowledge of conditions and an experience such as no automobilist in this or any other country has gained."

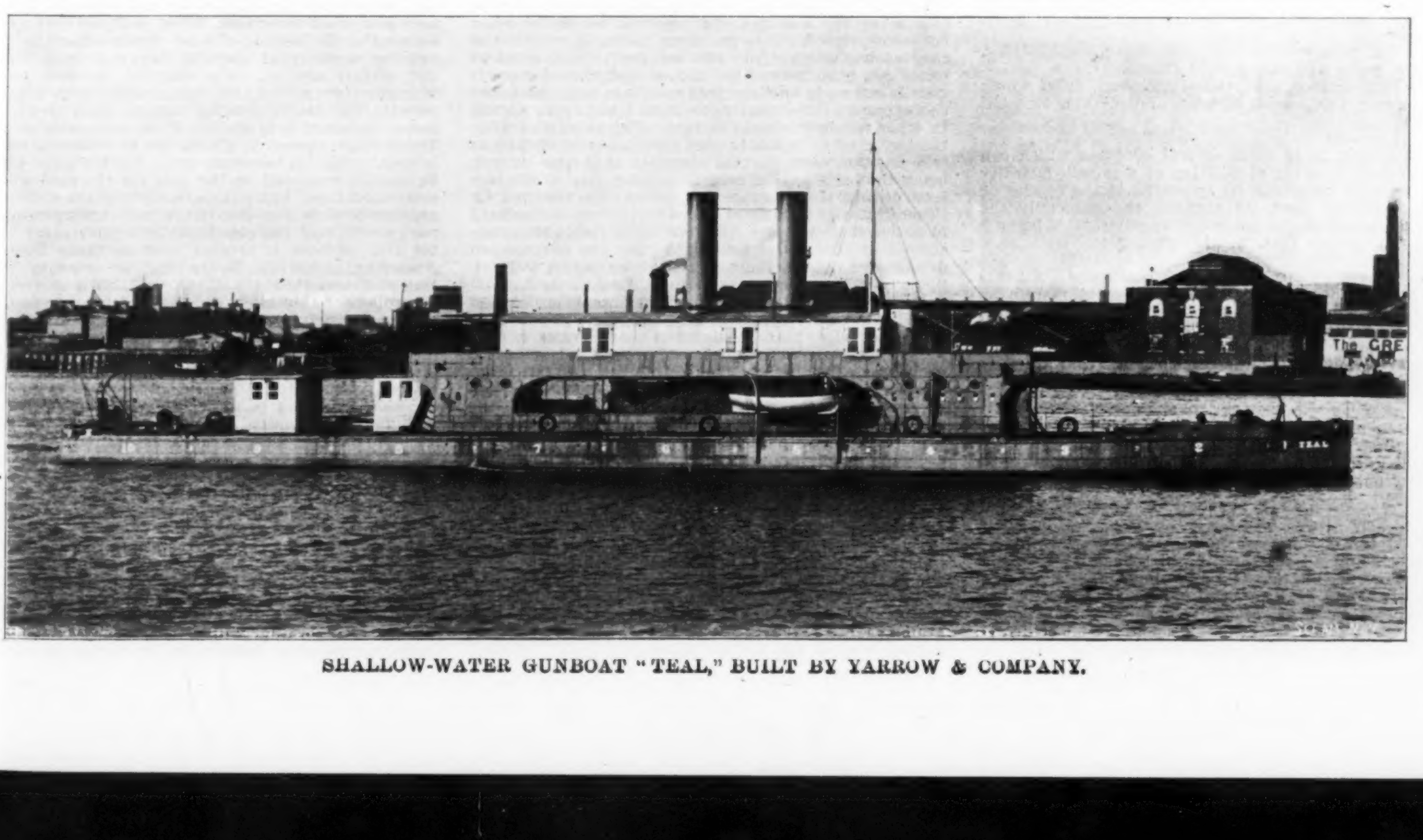
When, after serious deliberation, he decided to abandon the trip he said: "If I attempt this game again I will construct a machine on peculiar lines. No man who expects to operate in the civilized portions of this continent would take the machine for his individual service about cities and throughout ordinary country, but I tell you it will go through sand—and this quicksand at that."

There is nothing more to tell. We left Mill City that night and rode into Winnemucca on a freight train. The machine, aided by its own power, had been hauled from its bed by horses and returned to Mill City, where arrangements were made to load it for Cleveland.

We left Winnemucca May 30, at 2:40 P. M. on a Southern Pacific passenger train, and arrived in Cleveland June 2 at 7:35 P. M.

NEW TYPE OF RIVER GUNBOAT.

THERE has recently been tried on the River Thames a new type of river gunboat which has been constructed for service in shallow waters. The vessel, as shown in the accompanying photograph, for which we are indebted to her builders, Yarrow & Co., of Poplar, London, England, is a shallow hulled craft of very light draft for her dimensions. She is 160 feet in length, with a beam of 24½ feet, and a normal draft of 2 feet 3 inches. On the official trials, indeed, the draft was



SHALLOW-WATER GUNBOAT "TEAL," BUILT BY YARROW & COMPANY.

somewhat less than this, being 2 feet 2¼ inches, and this with a load of 40 tons on board. The mean of six runs on a measured mile showed a speed of 13.04 knots an hour, which was attained without forced draft, and when wood was being used for fuel.

The hull of the "Teal," as she is called, is built of galvanized steel, and is divided into ten water-tight compartments. Each compartment is so constructed as to be capable of floating independently of the others —a system of construction which makes it possible to put the vessel together while the sections are afloat, and avoids in localities where skilled labor may not be available the delay and trouble of riveting up and launching. The vessel is propelled by twin-screws, driven by two sets of compound surface-condensing engines, which are run at about 300 revolutions per minute. A curious feature of the construction is the fact that these propellers are much larger in diameter than the draft of the vessel, and that in order to insure that they will at all times be working in water, they are located in two special tunnels, which are formed parallel with, and on each side of, the keel of the vessel. Access to the propellers is gained by means of manholes on the main deck, and it takes but twenty minutes to remove a propeller and put another in its place.

Steam is supplied by a pair of Yarrow water-tube boilers, and forced draft is provided for use when the wood fuel may happen to be green. The vessel is armed with two 6-pounders, rapid-fire guns, and six .303 Maxims, all of which are mounted on an upper or battery deck, which extends for about half the length of the vessel amidships. This battery deck is housed in, and provides accommodation for the Europeans on the vessel. Its bulwarks, and also the sides of the vessel in the way of machinery and of the cabin accommodation for the officers on the main deck, are protected by Cammell chrome steel, of sufficient thickness to be proof against rifle-fire at point-blank range. On the main deck there is accommodation for the native crew, and also a sick-bay. The vessel is fitted with four rudders which are controlled by steam and hand-steering gear.

These rudders are used to give more complete control of the vessel in sharp bends of the river, or where eddies and currents are strong; the "Teal" is, in fact, so readily handled that she can describe a complete circle in a little more than her own length.

CHARCOAL PRODUCTION AND RECOVERY OF BY-PRODUCTS IN GERMANY.

By Consul-General MASON, of Berlin.

IN compliance with a request from a resident of Michigan a department instruction was sent, November 20, 1900, to consular officers in Germany, Norway and Sweden, asking for information relative to charcoal production and by-products.

Coincident with the development of coke manufacture in Germany by the use of retort ovens which recover the ammonia, gas, tar and its valuable derivatives that are wasted by the primitive "beehive" oven process, has been the improvement in methods and apparatus for wood distillation, through which the production of charcoal has been raised from the archaic, wasteful, earth-kiln process that recovered only charcoal and tar, to an intelligent, scientific system, by which every valuable element in the wood is saved and added to the wealth-producing power of the forests. So far has this been carried, that special patented processes have been devised for using even sawdust and the rough outer bark of trees as material for the manufacture of charcoal and other products.

The apparatus for wood distillation, which will be briefly described in a later section of this report, includes cast and plate iron retorts of various types, as well as ovens of masonry, together with pipes, coils, tanks, and pans for condensation and rectification of the several distillates and utilization of the gases. Retorts are heated either by direct firing from beneath or by superheated steam introduced in coils. Retorts with direct heating by fuel or gas flame are most in use, and they are of two general classes—the horizontal and vertical.

I.—THE PRODUCTS OF WOOD DISTILLATION

form four primary groups, which, with their principal derivatives, may be synopsized as follows:

(1) Uncondensed gases, which may be burned as fuel or, after certain treatment, used for illuminating purposes.

(2) Tar, from which are derived benzol, naphthalene, paraffin, rosin, and phenyl acid (creosote).

(3) Pyroligneous acid (wood vinegar), from which are derived acetic acid, acetone, and methyl, or wood alcohol.

(4) Charcoal.

The quantities of these several products which can be obtained from the distillation of a certain quantity of wood vary considerably, according to the species or kind of timber used, its dryness, and especially the time consumed by the process of distillation, it being a general principle that, within reasonable limits, slow distillation yields larger percentages of distillates than are recovered when the process is quickened. All this has been reduced to exactly demonstrated results by the German chemists, and these have been tabulated by Prof. Fisher in his Chemical Technology to show the comparative yield, by slow and quick distillation, respectively, of the seven species of wood that are most employed for charcoal manufacture in Germany.

II.—NATURE AND USES OF THE SEVERAL DISTILLATES.

Taking up these several by-products in their order, the second in commercial importance is probably the wood tar, which is found more or less in all kinds of timber, but most plentifully in the larches and other conifers.

A.—The Tar Products.

Wood tar is composed mainly of several hydrocarburets, the most important of which have been isolated as follows: Benzol (C_6H_6), toluol (C_7H_8), xymol (C_8H_{10}), cumol (C_9H_{12}), naphthalene ($C_{10}H_8$), and paraffin ($C_{20}H_{42}$), all of which are chemically neutral, besides the following acids: Phlenic acid (C_6H_6O), kresylphenol (C_7H_8O), and phenyl acid ($C_8H_{10}O$). Some of these have only a scientific interest and need not be separately discussed in a report of this character. The tar which contains them is expelled from the wood at temperatures exceeding 360 degrees Celsius. The higher the temperature and the more rapid the process of distillation, the greater the percentage of tar and gas produced and the smaller the yield of acetic acid. The tar obtained as a by-product of charcoal manufacture from hardwoods is mainly used for the production of creosote and applied to the antiseptic treatment of wood, such as posts, railway ties, paving blocks, etc., to protect the fiber against decay. When used as a raw material for producing any of the above-named hydrocarburets, that forms a separate chemical industry. The best known of them are:

Benzol, which boils at 82 degrees Celsius and has a specific gravity of 0.85.

Tuluol, which boils at 111 degrees Celsius and has a specific gravity of 0.87.

Xymol, which boils at 139 degrees Celsius and has a specific gravity of 0.875.

Cumol, which boils at 166 degrees Celsius and has a specific gravity of 0.887.

Cymol, which boils at 175 degrees Celsius and has a specific gravity of 0.85.

By reason of these sharply defined characteristics, they can be rather easily separated, and when treated with ammonia, produce bases, which, being oxidized, yield aniline colors. Industrially, however, anilines are mainly produced from the cheaper benzol and other derivatives from coal tar. The principal value of these elements when derived from wood tar is that they serve for a vast range of interesting researches for new and valuable shades of colors. Naphthalene and paraffin are the hydrocarbons which occur in small proportions in wood tar. Naphthalene is converted by treatment with nitric acid into nitronaphthalene, from which is obtained naphthylamin, an important material for the production of certain red and yellow aniline dyes.

The paraffin in wood tar is characterized by a remarkably high smelting point—360 to 400 degrees Celsius—and is of small industrial importance, for the reason that it can be obtained so much more abundantly and cheaply from coal tar. Of the oxidized, and therefore acid, combinations in wood tar, phlorol and kresylphenol have been isolated and have a certain scientific interest. Both these contain carbolic acid (C_6H_6O), and all are usually left in the liquid creosote, which is used as an antiseptic for the impregnation of wood to prevent decay.

B.—The Acid Products.

By far the most important by-product of wood distillation in charcoal manufacture is the pyroligneous acid, or wood vinegar, which in its raw state, as it comes from the still, is an impure hydrated solution ($C_2H_4O_2$), a colorless, inflammable liquid, with a sour, pungent smell and, as already stated, 12 per cent of pure acetic acid. It boils at 117.3 degrees Celsius and at 4 degrees the acid solidifies in laminated crystals which fuse at 16 degrees C. From the table on a preceding page of this report, it will be seen that the yield of pure acetic acid is highest in the hardwoods, viz., 6.43 per cent in blue beech, 5.63 per cent in birch, and 5.21 per cent in white beech, whereas the larch yields only 2.69 per cent and spruce 2.3 per cent under slow distillation. Pure acetic acid is derived from raw wood vinegar by several processes, the simplest of which is as follows:

The raw distillate is first left standing for a certain time to permit the tarry elements which it contains to separate by settling. The clarified liquid is then put into a retort, with rectifying apparatus attached, and heated until the methyl alcohol and other light and volatile elements are expelled and pass over into a distillate, which is reduced by subsequent processes to alcohol and acetone, as will be elsewhere described in this report. The heating is continued until the areometer shows a specific gravity of 1,000, indicating that the lighter elements have been eliminated. The acid solution is then drawn off and neutralized with a base —usually lime or soda. This takes up the acid forming an acetate, which, on being decomposed, yields acetic acid. The cheapest base for this process is limestone, but it should be pure, or as nearly as possible free from organic impurities, which would, until eliminated, injure the quality of the acetate.

Acetic acid is sufficiently powerful to expel the carbonic acid in limestone, but the neutralization process causes thereby a strong effervescence, so that it must be accomplished in large, deep tanks in which the effervescing mixture will not boil over. If, instead of limestone, pure burnt lime is used, the effervescence is greatly reduced; but in either case it is important that the amount of basic material should not be in excess. In other words, it should be just sufficient to neutralize the acetic acid—which it does first—and not enough to take up afterward the acid elements of the tar, which, being lighter than the acetate of lime, rise to the surface during the reaction and should be removed by skimming. The clarified solution is then evaporated in large shallow pans, yielding as a residuum crude acetate of lime. Overheating during the evaporation decomposes the acetate, so that a slow, steady, and uniform heat is necessary, and for this purpose the off-gases from the retorts in which the wood is distilled are used whenever practicable. The crude residuum is a gray, odorless mass, containing about 75 per cent of pure calcium acetate, and forms a standard article of commerce. It is purified by dissolving in water, filtering the solution through boneblack, and concentration by evaporation to a specific gravity of 1.16, when the salt crystallizes in small odorless needles, which are principally used as material for the production of acetone.

Acetate of lime appears in commerce in three grades of purity, the highest of which is now worth in large quantities 2.50 marks (60 cents) per kilogramme (2.2046 pounds); the medium grade, 40 cents; and the lowest, 33 cents per kilogramme. Its growing importance as a commercial product will be inferred from the fact that the exports of acetate of lime from Germany in 1898 were 8,529,300 kilogrammes; in 1899, 10,005,700 kilogrammes; and in 1900, 15,378,600 kilogrammes (33,295,000 pounds), of which last 1,382,140 pounds went to the United States.

When soda is used as the neutralizing base, the product is acetate of soda, and the process throughout is in general similar to that when lime is employed. The acetate of soda has various uses, but its crystals disintegrate when exposed to the air, and for this and other reasons it is less important in Germany than acetate of lime. Both are used as a means of extracting acetic acid from the raw wood vinegar, after which they are decomposed by various processes to obtain the crystallized acetic acid. When pure acid is to be obtained on a large scale, the soda acetate is preferred, as the acetic acid obtained from calcium acetate contains impurities which are difficult to eradicate. In either case, however, the acetate is decomposed by the action of a mineral acid, sufficiently powerful to displace the acetic acid from combination with the base, by which process the former is isolated.

Pure acetic acid is used for many purposes, among others making edible vinegar. When prepared for this use, it must be carefully cleansed from empyreumatic impurities, which give it a disagreeable, smoky flavor. This is accomplished by decomposing crystallized or freshly molten anhydrous acetate of soda by the admixture of 36 parts to 100 of sulphuric acid, which yields 80 parts of acetic acid of 54 to 55 per cent purity, and this is further purified by dissolving in water, distilling, and rectification. The process leaves as a residuum bisulphate of soda, which it requires a complicated process to utilize, and the distillation has to be performed in glazed or silver-lined retorts and cooling tubes in order to prevent the acetic acid from becoming contaminated with iron or copper. The resulting product, known in commerce as "essence of vinegar," can be made into table vinegar by dissolving in twenty times its volume of water. Of the

C.—Direct Derivatives from the Acetic Acid

the most important is acetone (C_3H_6O), a colorless liquid which is used as a solvent in aniline and several other branches of chemical manufacture, especially in the production of smokeless powder and other explosives. Acetone is obtained by separating acetic acid into three elements—acetone, carbonic acid, and water. For this purpose the acetic acid is neutralized with lime, and the acetate thus formed is heated in a retort with a stem leading to a coil condenser. On account of the low boiling point of acetone (56 degrees C.), this coil must be kept at a very low temperature to produce complete condensation. In the industrial process, the acetate of lime is dried, finely pulverized, and then put into the retort, where it is heated until the acetone has all passed over, when the residuum is withdrawn and again used for making fresh acetate of lime, with which the operation is repeated. Acetone of 56 to 58 degrees purity is now worth about 50 cents per kilogramme (2.2046 pounds), and, like acetate of lime, is a standard commercial product. It may be further decomposed and yields metacetone ($C_6H_{10}O$), a fragrant aromatic liquid which boils at 84 degrees C. and is used as a solvent for essential oils in the manufacture of perfumes.

The next valuable derivative from acetic acid is wood spirit or methyl alcohol (CH_4O), called in German "Holzgeist," a colorless, volatile, and inflammable liquid which boils at 66.3 degrees C. and has a specific gravity of 0.800. It burns with a bluish flame of low illuminating power, dissolves resins, gums, and essential oils, and is extensively used in the manufacture of lacs and varnishes and for the denaturalization of spirits which are to be used for industrial purposes. The exports of wood alcohol from Germany in 1899 amounted to 6,703,620 pounds, valued at $662,354.

Among the other useful products of wood distillation is oxalic acid, an important substance in dyeing and cloth printing, which was formerly prepared by oxidizing sugar, but is now much more cheaply obtained from sawdust by the action of alkalies.

In anticipation that the European process of making charcoal with recovery of the tar and acid products might have a practical interest for charcoal manufacturers in the United States, an engineer familiar with this industry has been consulted, and he has obtained from several German manufacturers of apparatus and fixtures for these purposes estimates of the cost of equipment for a plant of the standard capacity, viz., 75 cubic meters (2,649 cubic feet) of wood per day. In practice, it has been found most economical to set up the distillation plant as near as possible to where the wood is cut; in other words, at the point where all conditions of transportation for raw material and products are most favorable. The ordinary practice involves the distillation of hard woods—beech or oak—and the recovery of charcoal, tar, raw wood vinegar, and methyl alcohol. The charcoal, or first product, is ready for market on being withdrawn from the retort. The tar is sent as raw material to chemical factories, where it is worked up as a separate industry. The methyl alcohol is also a commercial product and is usually sold in its crude state; but the wood vinegar is usually consumed on the spot for the production of acetate of lime, which, as already explained, is a convenient vehicle for recovering and transporting the pure acetic acid contained in the wood vinegar, which for this purpose is treated with ordinary limestone. Assuming, therefore, that a firm or company in the United States should wish to establish a modern German plant of this kind, and for that purpose to obtain the necessary machinery in this country, the calculation would be somewhat as follows:

Distilling apparatus complete, without buildings, for treating 75 cubic meters (22½ cords) of wood per day, would cost here 105,000 marks ($24,990). If the capacity were increased to 100 cubic meters (30 cords) per day, the cost of plant would be about 130,000 marks ($30,940). If greater capacity is desired, it would be advisable to duplicate the same apparatus, instead of further increasing the size of the unit.

If beech wood is used, the raw vinegar obtained will be from 40 to 45 per cent of the weight of wood, and the vinegar should yield from 9 to 12 per cent of pure acetic acid. Assuming that this is to be recovered on the spot, a plant for the daily production of 1,200 kilogrammes (2,640 pounds) of acetate of lime would cost, exclusive of buildings, about 15,000 marks ($3,570). This assumes that the raw pyroligneous acid is to be treated with ordinary limestone, a process which involves no technical difficulties. So far as can be ascer-

tained, the apparatus for the industry involves few or no essential features which are covered by patents, so that a modern scientific plant, once established and its success demonstrated, could be duplicated to any extent which supply of material and the market for its products might require.

IS ALCOHOL A FOOD, A POISON, OR BOTH?

Dr. JOHN MADDEN, Professor of Physiology in Milwaukee Medical College.

THE greatest anomaly of our present day civilization is our attitude of indifference toward the existing wholesale poisoning of our people by alcohol. The reasons for this indifference are many. They are a part of the history of civilized man; for alcoholic poisoning is as old as civilization itself. They form a psychological question, complicated and far-reaching. They offer a field for research as interesting as any which now engages the attention of scholars, and a clear presentation of them would lay the foundation of a movement against alcoholic beverages which would be productive of the greatest results for the good of mankind; for it does not seem possible that a nation of sane, intelligent, progressive men could remain indifferent to the question once the magnitude of the evil was fairly and impartially presented.

There is, however, no thought of discussing either the history or the psychological aspects of the alcohol question at this time; but only to consider it in that special aspect indicated by the title of this paper from the standpoint of the physician and physiologist.

As to whether alcohol is a food or a poison is not a new question. It was discussed by Liebig and his confreres fifty years ago. Within the last two years, however, there has been a recrudescence of the whole discussion, and it still continues; but while, in the time of Liebig, physicians were almost exclusively interested in the subject, and its discussion hardly passed outside of medical circles, the layman has had much to do with the present agitation.

Moderate drinking has its advocates. By some peculiar form of mental gymnastics there are many good citizens who hold that it is "intemperate" not to drink at all as well as to drink to excess, and that the former is just about as reprehensible as the latter. During the present discussion, this view has received a good deal of support from a source which is regarded as authoritative on medical questions by everyone except the members of the medical profession. This *ex-cathedra* authority, speaking through the columns of the influential lay press, has undoubtedly exerted a great deal of influence, and the cause of those who are seeking to teach the truth about alcoholic poisoning has suffered thereby.

It might occur to the casual observer that it is hardly necessary to invoke the aid of chemical physiology to prove the poisonous effects of alcohol upon the human organism. Evidence of this kind is common enough—so common, indeed, that one can scarcely walk the streets of any of our cities without seeing alcoholic poisoning in some degree. The physician has had to deal with it from the day he began the practice of his profession. His aid has been invoked not only by the fashionable young man, who has made a night of it with his friends, to suffer horrible distress of head and stomach the next day; not only by the pitiable victim of delirium tremens; not only by the man who has irreparably damaged his kidneys, his liver, or his heart by "moderate drinking;" but he is frequently called upon to aid in that almost hopeless task of making the degenerate child of the alcoholic parent a normally sane, healthy, and useful member of society. The physician knows that chronic alcoholic poisoning in the parents causes many of their children to die in infancy. He also knows that should they escape death until adult age there is no form of nervous disease of which they may not be the victims, including an uncontrollable appetite for alcoholic narcotism. He knows also that the child of the alcoholic inebriate as well as the inebriate himself possesses a vulnerability to bacterial diseases caused by alcoholic poisoning which diminishes his chances of making a recovery from many of those diseases at least 50 per cent.

But is it not absurd to even suggest the question as to whether alcohol is or is not a poison? Do not its poisonous effects permeate all classes of society? Are they not to be found in plenty in our almshouses, our insane asylums, our penal and reformatory institutions? Are there not, at the present time, at least 1,000,000 of our people suffering from them in some form or degree?

When these charges against alcohol are made, the truth of them is at once admitted, but the objection is immediately raised that they are true only when alcohol is taken in excess, that small quantities of alcohol are oxidized and give rise to physiological energy. Indeed, this proposition has been of late reiterated so persistently that the reading public must have become rather familiar with it, and reiteration has given it some sort of currency. Let us see how much truth it contains.

Foods are for the purpose of repairing the damage done to the organism through the performance of its functions, or of furnishing material which, by its oxidization, supplies the organism with heat and force. In more familiar terms, the organic machine wears out and must have material to rebuild the worn-out parts; it needs energy to keep it at work, and heat to keep it warm, and must have a proper kind of fuel to furnish both.

Manifestly the food material which goes to rebuild the machine must contain the same elements as the machine; so, as the machine contains nitrogen, the food must also contain nitrogen. In the foods which are taken merely for the purpose of supplying energy, nitrogen is not necessary. Foods are, therefore, divided into nitrogenous and non-nitrogenous classes. Lean meat, fish, eggs, milk, cheese, gluten of grains, and many other animal and vegetable substances contain nitrogen, and, therefore, belong to the first class.

The second class is made up of starches and sugars, fats and oils, because these contain no nitrogen and cannot, therefore, enter into the structure of the organism, but, being readily oxidized, or burned up, they are a proper source of energy to heat the body and enable it to carry out its functions.

But all substances containing nitrogen are by no means proper foods for renewing the worn-out organism; nor are all readily oxidized substances available as fuel. There is an unlimited supply of nitrogen in the atmosphere, but the body cannot use it until it is first built up into a complex organic molecule, vegetable or animal. Carbon, too, is a constituent of all foods, but the coal bin may be full and it will yield nothing to a starving family.

More important than mere availability in the present discussion is the fact that many substances which contain all the elements necessary for foods cannot be used as such because they injure the organism. Strychnia, atropia, morphine, Indian hemp, and many substances found in putrefying meats and in some specimens of fungi are made up of organic molecules containing nitrogen, yet these are unfit for foods. Indeed, in very small quantities they cause death. They are, in short, poisons. The same is true of many organic substances which do not contain nitrogen. While readily oxidized when taken into the body their harmful effects upon the organism preclude their use as foods. Now, some of these substances are fatally destructive when taken in very small quantities, a fraction of a grain of strychnine or atropia being sufficient to kill an adult man. Others are less poisonous, taking considerable quantities to bring about a lethal issue. But we surely shall not be wrong if we reject all substances as foods which cannot be taken in quantity sufficient to fulfill their particular mission without injuring the organism; and still more certainly shall they be rejected if in such quantity they produce death.

Now, it is a well-known fact that poisons make their effects manifest by causing a more rapid breaking down of cell protoplasm. Cell protoplasm is that peculiar substance which forms the bulk of all tissues which have active functions to perform; it wears out in performing these functions and is renewed by proper food. These tissues are called the nitrogenous tissues, and the changes they undergo in building up and tearing down are spoken of as "nitrogenous tissue metabolism" or "nitrogenous metabolism," for short. No substance can be regarded as desirable food if it hastens the breaking down of the nitrogenous tissues, or, as we say, "increases nitrogenous metabolism." Still another fact must be stated before we have the completed picture of bodily nutrition, that is, that whenever the amount of food ingested is insufficient the body draws upon its own tissues for material to keep up its proper functions; therefore, whenever the food is insufficient the body loses weight; but it is the stored fat which is first consumed. On the other hand, the ingestion of any substance which irritates cell protoplasm is followed by a loss of *nitrogenous* material, a much more serious matter than the loss of *fat* merely.

Let us keep these facts in mind while we study the effects of alcohol upon nutrition, as they have been brought out by many different investigators.

Since alcohol contains no nitrogen it cannot, of course, take any part in the building up of wasted or worn-out tissue. That alcohol is almost completely burned up when taken in quantity of a half ounce, or a little more at a time; and that its burning is attended by the production of heat, is also proven by exact methods of experimentation. In spite, however, of the fact that it is burned, and heat is thus produced, the temperature of the body is raised for only a few moments and then falls below the normal. These phenomena are due to one of two causes, or both of them, namely, alcohol produces a temporary dilatation of the surface vessels and thus increases heat radiation sufficiently to more than compensate for the increased production of heat, if more heat is really produced; or, the narcotic effects of the alcohol diminish the heat produced by lessening chemical change. It is quite certain, however, that the first cause given is entirely responsible for the fall of temperature. Recent experiments have been made upon this same point, and the conclusions drawn therefrom differ from those above, which are universally accepted by physicians to be true; but these conclusions were based upon a misinterpretation of results. We may say, therefore, without fear of successful contradiction, that alcohol is not a source of bodily heat.

We will leave out of this discussion the question as to whether alcohol, when digested, is consumed and the stored fat of the body thereby protected; it is a complicated question, and its literature contains so many technicalities and contradictions that there would accrue to the lay reader no profit in its rehearsal. Let us, therefore, pass at once to the subject of the effects of alcohol upon cell protoplasm.

That alcohol is a poison when taken in large or considerable quantities has already been sufficiently pointed out; that both the animal and vegetable cell speedily succumb when brought directly in contact with it is abundantly proven. Precisely the same kind of effects are produced when it is taken in small quantities, the difference being not one of kind but of degree.

There is not room in this brief paper to even give an outline of the experimental work done to determine the effects of alcohol in nitrogenous metabolism. Leaving out of the discussion the work of Liebig, Molesworth, and later, Mayer, who would estimate the value of a food entirely upon its latent energy, that is, upon the number of heat units it could produce on combustion, we come to the work of Binz, who declared in a paper read before the Congress for Internal Medicine held in Wiesbaden in 1888 that the power of alcohol to diminish the rate of nitrogenous metabolism was really the one fact in the effects of alcohol about which there was no disagreement in the scientific world. A year before this time, however, Romeyn, working with Forster, had published the results of a series of experiments showing that this statement was not only not true, but that in *no case* was there any evidence that alcohol prevented the tissues from breaking down; on the contrary, the giving of alcohol was, in some cases, followed by a very decided increase in nitrogenous metabolism. Soon after this, Flechsig and Weiske arrived at the same results. They gave a sheep food rich in nitrogenous substances, but, in spite of this, there was a great increase in the rate of nitrogenous metabolism. Kellar made experiments upon himself with like results. On the three days preceding the day upon which he took alcohol the amounts of waste nitrogen were 20.9 grammes, 22.0 grammes, and 22.2 grammes, respectively. The day upon which the alcohol was taken the amount was 20.8 grammes; but on the three days following the alcohol day the amounts were 23.1, 23.1, 23.1 grammes, respectively.

The experiments of the Japanese physiologist, Miura, are peculiarly interesting and significant. He first put himself into such condition, by taking just enough of the right kinds of food, that he neither lost nor gained. He was, indeed, taking exactly enough to supply all the bodily wants, both of material for repair and for fuel. He now left out a part of his starch and sugar diet and took an amount of alcohol known to have the same heat value as that of the food left out; but the alcohol did not protect him from loss. On the contrary, the nitrogenous loss was in every case increased in amount.

Van Noorden obtained identical results. In Chittenden's experiments, while there was no uniformity of result on the days upon which alcohol was taken—sometimes the nitrogen loss was greater, sometimes less—on the days following the alcohol day there was uniformly evidence of increased tissue destruction, and in one case this increase was very great. Schönseifen demonstrated the same point. In his experiments he withdrew a portion of the starchy food, as did Miura, and substituted more than enough alcohol to make up the loss. In spite of this, however, the tissues gave evidence of an increased breaking down. Still more recent experiments carried out with, in one case, a man accustomed to taking alcohol daily, and another who was a total abstainer, showed an increase in tissue loss only in the latter.

The evidence seems to be complete. So far as we know to the contrary, in not a single case where alcohol has been given to a non-habitual user of alcoholic beverages and the results studied carefully, have we found alcohol a conservator of the tissues, but in all cases it has hastened their destruction, as has been shown by the increased output of the products of their waste. We must remember, too, that this has been the result when alcohol has been given only in that quantity which is said to be completely oxidized in the body.

The conclusion to be drawn from the foregoing evidence is plain: it shows that alcohol as a heat-producing food is a failure; there is no definite evidence to show that it protects the stored fat from oxidization, and even in the so-called small quantities, it hastens the breaking down of cell protoplasm. Is it not, therefore, clearly a poison in small as well as in large quantities?

There is one important consideration to which attention should be called which seems to have escaped the notice of all investigators of this subject of the effects of alcohol on nitrogenous metabolism, that is, the effects of alcohol upon the alcohol habitue must, of necessity, be different from the effects upon a non-user. It would be manifestly absurd to take a man habituated to the daily use of four or five ounces for months or years and make him the subject for the study of the effects of two or three ounces of alcohol upon the human organism. Habitual use of any narcotic is known to produce a tolerance for that narcotic, making it possible for the habitue to take several times the lethal dose to a novice, with safety. The man who smokes fifteen or twenty strong cigars a day without serious consequences would surely have been fatally poisoned had he smoked half that many on the day of his initiation into the smoking habit. If anyone doubts this let him recall the illness which resulted from his first smoke of, perhaps, a small part of a cigar. One-half a grain of morphine has been known to kill; but a recent victim of cancer of the tongue took ninety grains by the stomach, or between sixty and seventy grains hypodermically, on each day for some time before his death.

Certainly, then, any one who habitually takes alcohol in any quantity is not a fit subject for experiment, and all experiments performed upon him would be absolutely valueless for determining the effects of alcohol upon the system. It is quite probable that many of the negative results obtained were such because of this fact, for there is no room to doubt that the immunity conferred upon cell protoplasm by long continued contact with narcotic poisons protects it from breaking down, even though considerable quantities of the poison may be ingested.

There still remains to be considered the question as to whether the latent energy in small quantities of alcohol, converted into kinetic or active energy by oxidization in the body, does really contribute toward the helping of the various organs to carry out their functions. This point has never been demonstrated; for, indeed, it is not demonstrable. In order to prove it the subject of our experiment must receive only meat, or some other nitrogen-bearing food in proper quantity, and alcohol, the latter being substituted for the sugars, starches, and fats of an ordinary dietary. Let us see what would be the effects of making alcohol the sole source of non-nitrogenous food:

Moleschott's dietary calls for 40 grammes of fat and 550 grammes of starchy food; Atwater's, for 125 grammes of fat and 400 grammes of starchy food. Now, each gramme of fat when burned yields 9,312 heat units, while each gramme of starchy (carbohydrate) food burned in the body yields 4,116 heat units. It is therefore seen that Moleschott's dietary (that is, the non-nitrogenous portion of it) contains a latent energy of 2,636,280 heat units (grammes calorie); and Atwater's contains a latent energy of 2,810,400 heat units. Now, one gramme of alcohol contains in round numbers 9,000 heat units. It would, therefore, take about 293 grammes (9.1 ounces) of absolute alcohol to take the place of the fuel food in Moleschott's dietary; or 9.7 ounces of absolute alcohol for the same purpose in Atwater's. These amounts are equivalent to nearly one pint of strong whisky or brandy. This is the quantity that will have to be taken every twenty-four hours—a quantity which, very likely, would be fatal to the average adult unaccustomed to the use of alcoholic beverages.

Nor is there any indirect evidence that alcohol acts like the non-nitrogenous foods by generating tissue force. The well-known experiments of Dr. Hermann Frey in Sahli's Clinic, Berne, Switzerland, showed that these so-called small doses (one-fourth to one-half ounce) of alcohol, invariably lessened the capacity of the normal muscles for performing work. These experiments were most carefully conducted, Mosso's ergograph being used to measure the strength of the contractions. Since Dr. Frey's experiments, others have confirmed and strengthened his results. Nor must we forget Kraeplin's 1,350 experiments, which resulted in showing that "it has been experimentally proven that all the intellectual functions examined suffered a marked depression after the ingestion of small, moderate, and large doses of alcohol."

In the practical affairs of life experience has demonstrated precisely what the closest scientific investigations have disclosed, that alcohol has not only never been an aid in performing tasks involving the severest mental and physical exertion, but in all cases it has been a hindrance to the development of the highest human capabilities. Evidence of this kind meets the investigator on every hand, nor must he look to the "temperance" fanatic for the most emphatic expression of this sort of evidence. It comes from dispassionate, clear-headed, impartial men of science, whose entire lives are spent in discovering truth, rejecting everything which has not been tried and proven in the crucible of experimental evidence. Said Dr. Carl Peters, in his work on the German Emin Pasha Expedition: "At Baringo the last bottle of cognac was consumed; thereafter we had to drink only tea, coffee, and cocoa, and what, moreover, must be admitted, our health immediately became much better." Nansen's arduous journeys in Greenland, and almost to the North Pole, were made without a single drop of potable alcohol; and Helmholtz, probably the most acute thinker, probably the strongest man mentally of the nineteenth century, speaking at a celebration of his seventieth birthday of the ruin wrought to brilliant minds by alcohol, and the pleasure derived from the contemplation of physical problems, declared that "the smallest quantity of alcoholic drink seemed utterly to dissipate them." Indeed, there is evidence enough of this kind to fill pages and volumes of manuscript. Here, then, is our contention:

If those small quantities of alcohol oxidized within the body are to be called foods, should they not exhibit the characteristics of food by increasing the normal functions of brain or muscle? Is it not a fatal inconsistency to call any substance a food which does not give increased warmth to the body; but, instead, decreases the bodily temperature; which does not protect the nitrogenous tissues from waste, but does increase their rate of metabolism; which does not give added power to the nerve cells of the brain, but, on the contrary, always decreases the quality of their products; which does not enable the muscle to contract more vigorously, but does, indeed, decrease its capability for doing work? The argument has been made repeatedly and reiterated persistently in the past year or two that the fact that alcohol being oxidized within the body was prima facie evidence that it contributed to bodily energy. But this is proven by incontrovertible evidence to be fallacious. Another argument much used in favor of the food value of alcohol is that physicians find it valuable in certain cases of extremely low vitality; that there are certain conditions of this kind which alcohol alone can reach. Such assertions as these are not easy to refute, simply because they are vague, and so much of a personal equation enters into them. The writer has seen many cases of this kind and has had many in his own practice in which the therapeutic value of alcohol was thoroughly tested, but he cannot recall a single case in which the alcohol given was known to have saved a life, or, indeed, to have been of any value as a food, and the majority of the best and most carefully educated and most experienced physicians of to-day are against alcohol in any quantity as a source of bodily nutrition.

Considering the foregoing evidence, are we not fully justified in calling alcohol a poison, meaning thereby that it is a substance inimical to the organism, producing injury in small, and death in larger quantities? Are we not, moreover, by the same evidence, fully justified in denying it a place in any classification of foods because it neither repairs tissue waste nor protects the organism, neither is it a source of organic force?

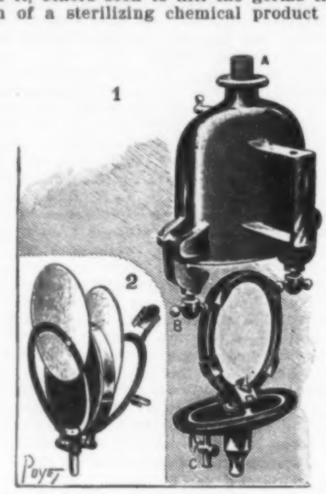
Let us continue to teach our boys and girls that alcohol is a poison; that the fact of its being oxidized in the body, if taken in small quantities, is not sufficient to constitute it a food; and that the normal man is never benefited by it in any quantity.

DOMESTIC PURIFICATION OF POTABLE WATER.

The desire to drink limpid water has in all times led men to clarify water that was not naturally clear; but, since the extension of Pasteurian ideas, the fact has had to be recognized that the clarification of water will give imperfect results if dangerous micro-organisms are not thereby eliminated, and that, from a hygienic viewpoint, a water may be harmful, although limpid, and, on the contrary, harmless and even wholesome, although roily. Thus, certain filters give water that is clear, although it contains more germs after filtration than before, and a limpid liquid, after having been submitted to boiling, may be roily, although freed from germs. Since the popularization of scientific ideas relative to the origin and transmission of epidemic diseases, such as typhoid fever, cholera, dysentery, etc., the public, influenced by commercial advertisements, has sought in special apparatus a security that it has not often found. The responsibility for such want of success has sometimes been attributed to the uncertainty of certain scientific principles of hygiene, despite the advice given by hygienists to the inhabitants of regions supplied by suspicious water to sterilize the liquid by boiling it before consumption, and to avoid the use of apparatus that are sometimes dangerous because they allow of the passage of germs, as in ordinary filters.

It is evident that in laboratories filtration effected with certain apparatus by bacteriologists may give good results; but in practice such is not the case, for germs pass through all filters after the latter have been for some time in use.

An endeavor has been made to render filtration more efficacious by different processes. Some of these consist in renewing the filtering surface before the germs traverse it, others seek to kill the germs through the addition of a sterilizing chemical product and afterward filtering the water through a porous material capable of entirely fixing such product, and others again kill the germs through heat and afterward clarify the water through filtration.



Figs. 1 and 2.—EDEN FILTER.

Fig. 1.—*A*, water inlet; *B*, nut for fixing the filtering element; *C*, cock for taking in non-filtered water and allowing of the escape of germs retained in the reservoir. Fig. 2.—(In cartouche.) Details of the filtering element. Carbon disk and disks of compressed paper.

We shall pass in review some of the principal apparatus that have recently been devised for the domestic purification of water.

Simple Filtration.—Among simple filters, we shall simply recall the porcelain tube apparatus of M. Chamberland, the asbestos filter of M. Garros, the compressed cellulose apparatus of M. Grandjean, the Mallie aerifilter, the Howatson silica filter, and the Delphia syenite filter, all of them apparatus capable of giving good results for a certain length of time, but all liable eventually to give water containing more germs after filtration than before unless they are closely watched and very frequently sterilized.

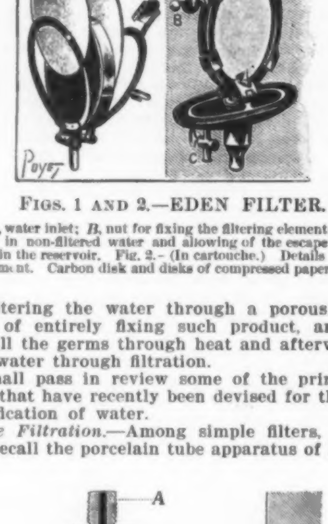


Fig. 3.—EDEN FILTER FOR WATER UNDER PRESSURE.

A, water inlet; *B*, exit of filtered water.

Systems with a Change of Filtering Element.—In MM. Grandjean and Prevet's "Eden Filter" (Fig. 1), the filtering substance consists of paper cellulose compressed in sheets and supported by a disk of agglomerated carbon (Figs. 2 and 3). The filtering parts are changed as often as possible. All the parts of this apparatus, which is of an elegant aspect, are well elaborated.

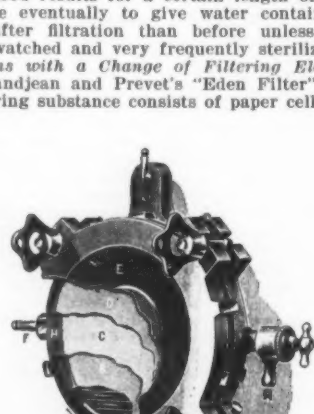


Fig. 4.—PASTEURIZING FILTER.

A, cap for reception of water to be filtered; *E*, cap for reception of filtered water; *F*, inlet for water to be filtered; *R*, cock for allowing of the escape of air from *A* at the moment of charging, and of the entrance of non-filtered water; *B* and *D*, disks of wire cloth with a rubber rim. *O*, exit for filtered water; *C*, filtering plate rendered impermeable at its periphery, *H*.

The Dame, Pottevin and Piat "Pasteurizing Filter" (Fig. 4) has much analogy with the preceding. The filtering element consists of disks of cellulose, of which the sterilizing power is calculated for a minimum of nine days, after which they must be discarded.

The principle of periodically getting rid of the germs accumulated on the other side of the filter is excellent and constitutes a progress. Nevertheless, the objection that can be made to such apparatus is that the part at which the water collects immediately after traversing the filter is contaminated during the operation of changing the disks, and that an organic material is employed as a filtering substance.

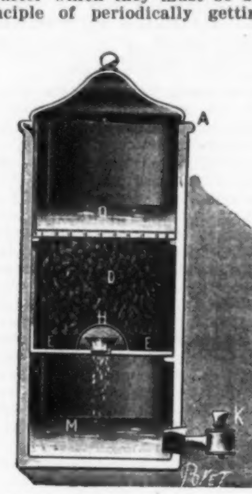


Fig. 5.—SAPRODAPT FILTER (SECTION).

A, air port; *D*, saprodapt; *E*, stratum of fine sand; *H*, bell; *K*, earthenware cock; *M*, filtered water; *O*, water to be filtered.

The Tillieux "Saprodapt Filter" (Fig. 5) employs as a filtering element a magnetic oxide of iron analogous to the "polarity" recommended by Mr. Howatson for the filtration of potable and sewage waters. According to certain English scientists, such oxides have the property of serving as a generator of ozone, which burns the organic matter and kills the germs. The "Saprodapt" might be frequently revivified by a current of air.

Use of Antiseptic Products Fixed by Filtration.—The Lapeyvere, Delsol and Fillard "Chemical Filter" (Fig. 6) is based upon the use of an alumino-calcareous permanganate powder which is added to the water in the proportion of 0.15 to 0.25 per liter, and which oxidizes organic matter, precipitates argillaceous substances and decarbonates calcareous water. The filtering is done through treble-milled flannel or through purified turf.

Fig. 6.—CHEMICAL FILTER.

In the Trouette "Lutece Filter" (Fig. 7) permanganate of lime is added to the water and the violet-red liquid is filtered through a block of binoxide of manganese. According to the manufacturer, this filter gives good results and the excess of the sterilizer is completely retained.

Fig. 7.—LUTECE FILTER.

In these processes of chemical action the public will always, and with just reason, have a certain fear of daily drinking a liquid into which an antiseptic—a "poison" for microbes—has been poured, and will be apt to think that what is poisonous to a microbian cell is equally poisonous to a human one. Nevertheless,

in certain cases, when we have to do with extremely dirty water, such as the stagnant water of ponds and swamps, especially in warm countries, such processes give excellent results and are of great utility.

The Use of Heat.—Hygienists everywhere recommend the boiling of potable water as the surest means of freeing it from microbes. This also is the process that comes within the reach of everyone, since it necessitates no special apparatus and is not expensive. For several years past there have been established apparatus that give quite a large quantity of water under pressure, sterilized by heat, such as those of

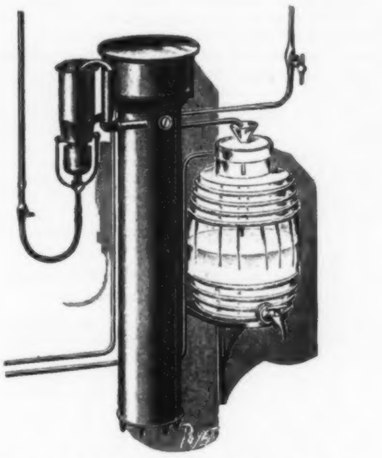


FIG. 8.—LEPAGE'S STERILIZER.

Rouart, of Geneste and Herscher, of the Societé de la Force Motrice Gratuite, of Vaillard and Desmaroux, and others. Finally, there has recently appeared the American sterilizer of Lepage (Fig. 8), which is the first domestic apparatus to give practically, rapidly, and continuously, cold and clarified water that has been previously raised to ebullition.

The impure and non-sterilized water fills the reservoir (Fig. 9), *A*, which is supplied either by a conduit, *B*, connected with a water main, or with any source whatever. The level of the water, *X X*, is kept constant in the reservoir by a float. The water, descending through the pipe, *C*, fills the compartment, *D*, and then the small boiler, *E*, up to the level, *X X*, where it stops. When the boiler is heated the water enters into ebullition, and a mixture of steam and boiling water, rising through the pipe, *F*, reaches *H*, which the sterilized water enters. This water accumulates in the compartment, *I J*, and then in the siphon, *K*. When the level is high enough to reach the top of the siphon, the water makes its exit through the extremity, *L*. After filtration, it is collected in any sort of receptacle.

The chemical and bacteriological researches that have been made with this apparatus have given excellent results. Water sowed with the bacillus of typhus and dysentery and the pyocyanic bacillus no longer contains these germs after its passage through the sterilizer.

A great progress, then, has here been made in the way of the domestic purification of potable water. Nevertheless, the apparatus that will give entire satisfaction to all hygienists will be the one that will permit of rapidly collecting cold, limpid and absolutely sterile water in houses. Such a result, however, it will be impossible to obtain until all the molecules of the water have been raised to a temperature of 130 degrees C. for at least ten minutes. But here the operation of an apparatus under pressure will peculiarly complicate the problem and doubtless render the domestic use of it improbable.

Such absolute sterilizers will, on the contrary, have to be sought for the sterilization of great masses of water in special stations. Moreover, the germs of cholera, typhoid fever and dysentery do not resist the temperature of ebullition of water, and, consequently, this operation effected in the kind of sterilizer under consideration offers sufficient guarantees and security. —For the above particulars and the engravings we are indebted to La Nature.

THE REVERSAL OF THE PHOTOGRAPHIC IMAGE BY CONTINUED ACTION OF LIGHT.

THE remarkable results described by Prof. Francis E. Nipher in developing photographic plates in daylight, bring to mind some of the earlier experiments upon the reversal of the photographic image. It has long been known that under particular conditions of overexposure in the camera a positive, instead of a negative, is produced by ordinary development. This result has been repeatedly observed by amateurs, much to their astonishment and mystification.

The present writer has several times attempted to bring about the effect by prolonged exposure in the camera, but without success. The necessary conditions not being known, the result is accidental and uncertain. The idea of giving a supplementary exposure of the plate in broad daylight did not suggest itself; indeed, it is not one that would spontaneously commend itself to a photographer. All his previous training and experience is opposed to it on general principles.

Nevertheless, it is not entirely new. Herschel, in the year 1839 or 1840, did very much the same thing. He observed reversals of photographic action, and so did Draper on strips of sensitized paper with which he was studying the chemical action of the sun's light in Virginia, and photographing the spectrum in ephemeral colors. This subject was referred to quite recently in an article by the present writer, entitled, "Tithonic Rays and Early Photographs in Color," published in the International Annual of Anthony's Photographic Bulletin, XIII. (1901), 107. At that time and also many years later, the effects observed were attributed to an antagonistic action between light radiations from different parts of the solar spectrum.

Many years ago, when collodion wet plates were mostly in vogue, there was considerable discussion among photographers of the effect of exposing sensitized plates to diffused daylight, either before, during or after the usual exposure in the camera. Some claimed that such a supplementary exposure made the plates more sensitive, so that the camera time was materially shortened. The admission of a little diffused light through a hole in the camera was claimed to be advantageous in the same way. Others questioned the utility of the practice and the question was finally dropped and forgotten.

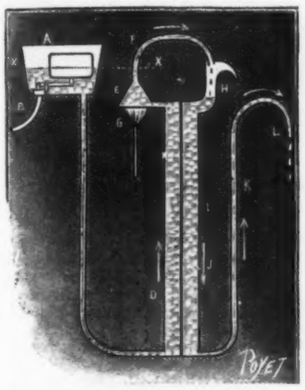


FIG. 9.—LEPAGE'S STERILIZER.

There may have been a basis of truth in the contention of those who advocated the supplementary exposure, but it was not satisfactorily established at the time. There is less reason for skepticism now than there was in those days. Although not exactly in line with Professor Nipher's work, the subject bears a close relation to it.

More directly connected with the recent observations is the work of M. J. Jansen, at Meudon, in the year 1880, when he was engaged in studying the solar radiations. In his original communication to the French Academy, published in Comptes Rendus of that year, he used the following language descriptive of his work: "I have the honor to inform the Academy of the discovery of a fact to which I have been led by my studies in the analysis of the light of the sun and of its photographic images.

"This fact consists in this, that the photographic images may be reversed, and pass from negative to positive by the prolonged action of the light which has produced them."

Ordinarily the exposures for negatives were about one-thousandth of a second, or when bromide plates were used, one ten-thousandth. But when the exposures were prolonged to half a second or a full second —increased 10,000 or 20,000 times—he obtained a positive picture instead of a negative.

The investigations were continued, and in a second communication to the Academy, also published in Comptes Rendus (Vol. XCI.), he made known some remarkable results.

By varying the times of exposure he found an intermediate condition of the plate at which neither a positive nor a negative could be developed. His conclusions may be briefly summarized here. With exposures of increasing duration he discovered six different successive conditions of the sensitive plate. These developed in order as follows:

1. A negative. The ordinary negative.
2. A first neutral condition, which blackened uniformly in the developer.
3. A positive.
4. A second neutral condition, opposed to the first, which became uniformly lighter in the developer.
5. A second negative, similar to the first but differing by the enormous amount of light required to produce it.
6. A third neutral condition, in which the negative of the second order has disappeared and was replaced by a somber, uniform tint.

These facts were established with different kinds of plates—tannin plates, gelatin-bromide and others.

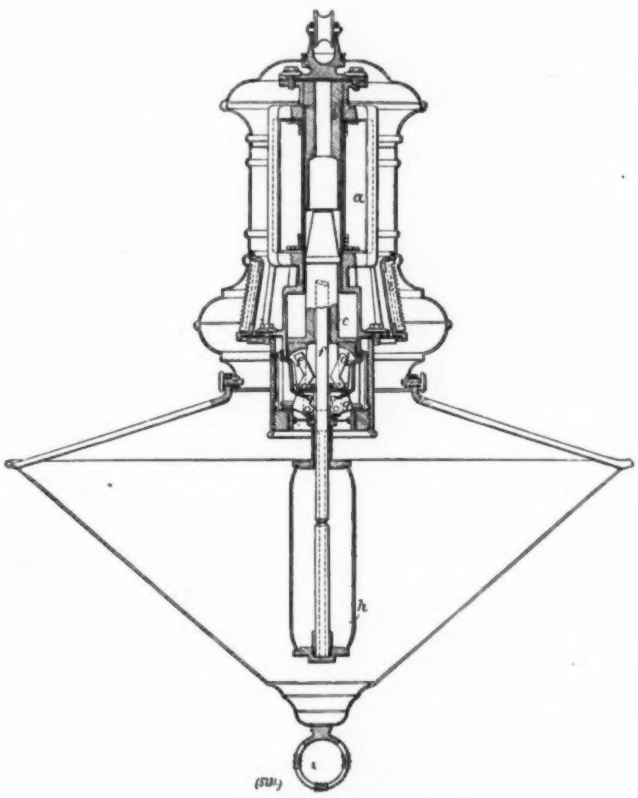
It is scarcely necessary to indicate the bearing of these observations on the results of Professor Nipher's experiments. Does not the fourth condition suggest that if a plate in that stage were developed in a lighted room it would show a negative picture?

About the time of these observations of Jansen, considerable attention was being directed to the subject of reversals of the photographic image; but most of the literature deals with theories in explanation of the facts. Although the discussion was sufficiently instructive and interesting, it does not seem to me that we are sufficiently acquainted with the chemical effects of light in photography to warrant much chemical theorizing in this particular field.—Romyn Hitchcock, in Science.

THE "ARK" LAMP.

MESSRS. JOHNSON AND PHILLIPS, of Charlton, Kent, have recently brought out an exceedingly simple arc lamp, which we illustrate in the annexed engraving. The special feature is that there is no upper carbon holder, the carbon being slipped into the lamp, and fed down automatically from time to time as it is consumed. The lamp is of the inclosed type, the arc being inside a small glass cylinder which is closed practically air tight, and the waste of the carbons is consequently very slow, one set lasting about 100 hours. The arc is struck and regulated by a solenoid, *a*, of which only a few convolutions are shown in the engraving. This coil surrounds a casting which at the upper end carries a fixed internal pole-piece, *b*. At the lower end the casting is of greater diameter, and incloses a movable core. This core is slotted at its lower part to provide space for four clutch cams, which are pivoted at their lower ends in a loose plate. The only connection between the core and the cams is a pin, *e*, at the back of each cam. When the core is raised, these pins force the cams inward, causing them to grip the carbon, *f*, and carry it with them. Conversely, when the core descends, and allows the plate which carries the cam to rest on the framework of the lamp, the grip of the cams is relaxed, and the carbons slide through them. The parts are shown as the lamp appears before the current is turned on. When the switch is operated the core is drawn upward, and the arc is struck. As the carbons waste, the core descends until the carbon slides through the cams and feeds itself down.

The current is fed into the upper carbon by four contact pieces, which are lightly pressed against it by gravity. Near the top of the carbon is a groove, not shown in the engraving, and when the contact pieces enter this groove they retain the carbon from descending further, and the lamp becomes extinguished. The lower carbon is fixed in a holder into which current is led by a conductor. The glass, *h*, insulates the lower holder from the lamp frame. The resistance coil is wound on the notched ribs, *j*, in a position in which the heat can be readily radiated. The lamp is exceedingly simple; indeed, it is difficult to see how it could possibly be made with fewer working parts.—We are indebted to London Engineering for the engraving and description.



THE "ARK" LAMP.

CONTEMPORARY ELECTRICAL SCIENCE.*

DARK CATHODE SPACE.—In most investigations of the distribution of potentials in discharge tubes, it is assumed that the potential is constant over any plane normal to the axis of the tube. Mebius has shown that the equipotential surfaces are concave with respect to the anode. A. Wehnelt has studied this question by a new apparatus, by means of which the potential at any point, whether axial or eccentric, may be determined. The device is simple. The cathode is attached to a flexible coil of wire, and may be moved to any position in the cylindrical tubes by means of a magnet. A side tube contains a probe, which, again, may be brought to any distance from the axis of the tube by means of a similar magnetic arrangement. The results obtained show that, as in the case of the anode, the equipotential surfaces are concave with respect to the cathode. The curve of potential is continuous in every case, and sharp bends, as found by Graham, must be attributed to faults in the method. The curve of potentials, like that of temperatures, is of the e^{-kx} form. The author makes a distinction between "free" and "influenced" cathodes, the latter being those which are influenced by the proximity of the tube walls. There is, however, no essential difference in the potential curves of the two types.—A. Wehnelt, Phys. Zeitschr., June 1, 1901.

ELECTRIC OSCILLATION EXPERIMENT.—H. Pellat describes an experiment which appears somewhat paradoxical at first, but which is easily explained by electric oscillations. Two condensers of very unequal capacities, say a battery of six large jars and a small Leyden jar, are placed in connection by means of a commutator mounted on ebonite columns, so as to be able to deal with high potentials. All the armatures, or at least three of them, are insulated. Two discharging rods are attached to the small condenser, and they show a spark when the difference of potential reaches a sufficient value. If now the condensers are charged so as to give them only half the charge necessary for producing sparks, or even a little less, and the connections are reversed, the spark passes between the rods. Since the reversal makes the positive coating of one condenser communicate with the negative coating of another, the difference of potential should diminish. Nevertheless, the discharge shows that at a certain moment the difference of potential between the coatings of the small condenser must have doubled at a certain moment. This is of practical importance as showing that reversal of connections may produce dangerous potentials. The author gives a full explanation based upon the current theory of electric oscillations.—H. Pellat, Comptes Rendus, May 13, 1901.

JAUMANN'S J-SURFACE.—If two electrodes, mounted in a vacuum tube about 2cm. apart, are both connected with the negative pole of an influence machine or an induction coil, and an influence machine or induction coil is made to produce a discharge in the circuit, a bright surface appears between the electrodes, and marks its traces on the walls of the tube by light-blue lines. When the leads are equal in length the surface appears midway between the electrodes, and when one of them is lengthened, the surface approaches the corresponding electrode. This phenomenon was first described by Jaumann and used by him to support his theory of longitudinal light. The experiments in question have been repeated by A. Korn, who has added an interesting new fact. The bright blue trace of the J-surface on the wall of the tube is not always straight. It is, in fact, generally speaking, wave-shaped, and the displacements of the surface are marked by a simultaneous progression or retrogression of the wave-line. Without entering into wide speculations, the author inclines to think that the oscillations are propagated into the electrode, and discharge is more vigorous from the more strongly oscillating electrode.—A. Korn, Ann. der Physik, No. 5, 1901.

A PERFECTLY ASTATIC GALVANOMETER.—M. Lippmann describes a galvanometer which is quite independent of the magnetic field of the earth. The principle is the following: A magnetic needle is suspended by a cocoon fiber and allowed to settle in the magnetic meridian. The poles project into coils whose axis is oriented in the same way, and which are traversed by the current to be measured. Hence the needle is displaced in the direction of its own length, and as the earth's magnetic field does not tend to displace a needle in the direction of its own length, that field is without influence upon the displacement, and is as good as non existent. The needle is, therefore, perfectly astatic. Its suspension is attached to one arm of a torsion balance, which gives the resistance to the displacement. That resistance can be made as small as desired, and the sensitiveness of the apparatus can be thus increased indefinitely. In a galvanometer devised by Becquerel the needle is attached to the arm of an ordinary balance, and sucked into a coil in the same manner. But it is obvious that the substitution of a torsion balance for an ordinary balance greatly increases the sensitiveness. The author obtained the best effects by using a thick and heavy needle strongly magnetized. He gives the mathematical theory of the instrument.—Lippmann, Comptes Rendus, May 13, 1901.

PERMEABILITY OF NICKEL STEELS.—René Paillot has employed the "isthmus" method for measuring the permeability of nickel steels in intense magnetic fields. Truncated pole-pieces, with a semi-angle of 60 degrees 30 minutes, were attached to a Du Bois electro-magnet, and gave a uniform field over a space 0.33 centimeter long and 0.6 centimeter wide. Bars of the metal to be tested, 0.32 centimeter in diameter, were suddenly withdrawn from between the pole pieces, and the inductions measured by a ballistic galvanometer. The first series of measurements was made with samples of "irreversible steel" containing 24.1 per cent of nickel and 0.3 per cent of carbon. It was shown that there is a distinct increase of permeability in raising the field intensity from 20,000 to 30,000 units. On the other hand, two samples of "reversible steel" containing some 27 per cent of nickel retained a constant permeability while the field varied from 4,000 to 30,000 units. This is quite in accordance with Guillaume's predictions. When the steel, besides the addition of nickel, contained also small quantities of chromium or manganese, the permeability showed a decided diminution of permeability with increasing field intensity.—R. Paillot, Comptes Rendus, May 13, 1901.

* Compiled by E. E. Fournier d'Albe, in The Electrician.

SELECTED FORMULÆ.

Cements and Lutes.—The following are some selected recipes:

ACID-PROOF CEMENTS FOR STONEWARE AND GLASS.

1. Mix with the aid of heat equal weights of pitch, rosin, and plaster of Paris.
2. Make silicate of soda to a paste with ground glass.
3. Make boiled oil to a paste with china clay.
4. Make coal tar to a paste with pipe clay.
5. Make boiled oil to a paste with quicklime.
6. Mix with the aid of heat: Sulphur, 100 lb.; tallow, 2 lb.; rosin, 2 lb. Thicken with ground glass.
7. Mix with the aid of heat: Rosin, 2 lb.; sulphur, 2 lb.; brickdust, 4 lb.
8. Mix with the aid of heat 2 lb. of India rubber and 4 of boiled oil. Thicken with 12 lb. of pipe clay.
9. Fuse 100 lb. of India rubber with 7 lb. of tallow. Then make to a paste with dry slaked lime and finally add 20 lb. of red lead.
10. Mix with the aid of heat: Rosin, 24 lb.; red ochre, 8 lb.; boiled oil, 2 lb.; plaster of Paris, 4 lb.

WATERPROOF CEMENTS FOR GLASS, STONEWARE, AND METAL.

1. Make a paste of sulphur, sal ammoniac, iron filings, and boiled oil.
2. Mix together dry: Whiting, 6 lb.; plaster of Paris, 3 lb.; sand, 3 lb.; litharge, 3 lb.; rosin, 1 lb. Make to a paste with copal varnish.
3. Make a paste of boiled oil, 6 lb.; copal, 6 lb.; litharge, 2 lb.; white lead, 1 lb.
4. Make a paste with boiled oil, 3 lb.; brickdust, 2 lb.; dry slaked lime, 1 lb.
5. Dissolve 93 oz. of alum and 93 oz. of sugar of lead in water to concentration. Dissolve separately 152 oz. of gum arabic in 25 gals. of water, and then stir in 62½ lb. of flour. Then heat to a uniform paste with the metallic salts, but take care not to boil the mass.
6. For iron and marble to stand in heat.—In 3 lb. of water dissolve first 1 lb. of waterglass, and then 1 lb. of borax. With the solution make 2 lb. of clay and 1 lb. of barytes, first mixed dry, to a paste.
7. Glue to resist boiling water.—Dissolve separately in water 55 lb. of glue, and a mixture of 40 lb. of bi chromate and 5 lb. of alum. Mix as wanted.
8. (Chinese Glue).—Dissolve shellac in 10 times its weight of ammonia.
9. Make a paste of 40 oz. of dry slaked lime, 10 oz. of alum, and 50 oz. of white of egg.

ARMENIAN CEMENT FOR JEWELERS.

Soak 8 oz. of isinglass in 64 oz. of water for 24 hours. Then evaporate on the water bath to 32 oz., add 32 oz. of rectified spirits of wine, and strain. Then mix in a solution of 4 oz. of mastic and 2 oz. gum ammoniac in 32 oz. of rectified spirit.

CASEIN CEMENTS.

For Metals.—Make a paste with 16 oz. casein, 20 oz. slaked lime, and 20 oz. of sand, in water.

For Glass.—1. Dissolve casein in a concentrated solution of borax.

2. Make a paste of casein and waterglass.

Marine Glue.—Make a very strong solution of India rubber, 2 oz., and asphalt, 4 oz., in benzole or naphtha.

PUTTIES.

1. Make 10 lb. of whiting and 1 lb. of white lead to a stiff paste with boiled oil. The white lead may be omitted.
2. *French Putty.*—Boil 7 lb. of linseed oil with 4 lb. of burnt umber for two hours. Then add 10 lb. of white lead and 5½ lb. of chalk.
3. *Wax Putty.*—Fuse together 4 lb. of yellow wax, 2 lb. of tallow, 1 lb. of oil of turpentine, and 6 lb. of Venice turpentine.

For Horn and Bone.—Mastic, 5 lb.; turpentine, 2 lb.; linseed oil, 6 lb.

CUTLERS' CEMENTS FOR FIXING KNIFE BLADES INTO HANDLES.

		Pounds.
1.	Rosin	4
	Beeswax	1
	Plaster of Paris or brickdust	1
2.	Pitch	5
	Wood ashes	1
	Tallow	1

CEMENT FOR BOTTLE TOPS.

Fuse together gelatine and glycerine.

CEMENTS FOR LEATHER, INDIA RUBBER, ETC.

1. Fuse together shellac and gutta percha in equal weights.

		Ounces.
2.	India rubber	8
	Gutta percha	4
	Isinglass	2
	Bisulphide of carbon	32
3.	India rubber	5
	Gum mastic	1
	Chloroform	3
4.	Gutta percha	16
	India rubber	4
	Pitch	4
	Shellac	1
	Linseed oil	1

Amalgamate by heat.

5. Mix 1 oz. of oil of turpentine with 10 oz. of bisulphide of carbon in which as much gutta percha as possible has been dissolved.

		Ounces.
6.	Amalgamate by heat:	
	Gutta percha	100
	Venice turpentine	80
	Shellac	8
	India rubber	2
	Liquid storax	10
7.	Amalgamate by heat:	
	India rubber	100
	Rosin	15
	Shellac	10

Then dissolve in bisulphide of carbon.

8. Make the following solutions separately and mix:

		Ounces.
(a)	India rubber	5
	Chloroform	140
(b)	India rubber	5
	Rosin	2
	Venice turpentine	1
	Oil of turpentine	20

CEMENTS FOR GLASS AND METAL, FOR ELECTRICAL APPARATUS, ETC.

		Ounces.
1.	Rosin	5
	Beeswax	1
	Red ochre	1

Amalgamate by heat.

2. Boil together 3 oz. of rosin, 1 oz. of caustic soda, and 5 oz. of water. Then make to a paste with plaster of Paris.

3. Make a mixture of mucilage of gum arabic and calomel.

		Pounds.
4.	Litharge	2
	White lead	1
	Copal	1
	Boiled oil	3
		Ounces.
5.	Copal varnish	15
	Boiled oil	5
	Oil of turpentine	2
	Glue made as strong as possible	5
	Dry slaked lime	10

6. Fuse 2 lb. of pitch and stir in 1 lb. of plaster of Paris.

CEMENT FOR IRON.

		Pounds.
1.	Graphite	50
	Whiting	15
	Litharge	15

Make to a paste with boiled oil.

2. Make a putty of white lead and asbestos.
3. Make a paste of litharge and glycerine. Red lead may be added. This also does for stone.
4. Make a paste with boiled oil of equal parts of white lead, pipe clay, and black oxide of manganese.
5. Make iron filings to a paste with waterglass.

		Ounces.
6.	Sal ammoniac	4
	Sulphur	2
	Iron filings	32

Make as much as is to be used at once to a paste with a little water. This remark applies to both the following dry recipes:

		Ounces.
7.	Iron filings	160
	Lime	80
	Red lead	16
	Alum	8
	Sal ammoniac	2
8.	Clay	10
	Iron filings	4
	Salt	1
	Borax	1
	Black oxide of manganese	2
9.	Mix: Iron filings	180
	Lime	45
	Salt	8
10.	Mix: Iron filings	140
	Hydraulic lime	20
	Sand	25
	Sal ammoniac	3

Either of these last two mixtures is made into a paste with strong vinegar just before use.

11. Make equal weights of zinc oxide and black oxide of manganese into a paste with waterglass.

CEMENTS FOR GLASS AND EARTHENWARE.

1. Fuse together shellac and half its weight of Venice turpentine.
2. (Transparent). Dissolve 1 oz. of India rubber and 16 to 24 oz. of gum mastic in 64 oz. of chloroform.
3. Soak plaster of Paris in a concentrated solution of alum. Dry the mixture, bake, and grind it. Mix with water for use.
4. (The famous Schio-Liao). Mix 3 oz. of blood, previously well whipped, with 4 oz. of slaked lime and a little alum.
5. Fuse together equal weights of rosin, yellow wax, and Venetian red.
6. Soak isinglass in water, and dissolve the swollen mass in glacial acetic acid.
7. Fuse together: Rosin, 8 lb.; plaster of Paris, 2 lb.
8. Fuse together: Rosin, 10 lb.; shellac, 2 lb.; rouge, 1 lb.

CEMENT FOR ZINC.

Make whiting and zinc dust to a paste with waterglass.

CEMENT FOR CELLULOID.

	Ounces.
Shellac	2
Spirits of camphor	2
90 per cent alcohol	6 to 8

Liquid glue is made by adding a little dilute nitric acid to hot glue made in the ordinary way. If too much acid is used the glue will never set.

The following are six approved recipes for lutes:

(a) Glue and plaster of Paris.

(b) Equal weights of almond paste and whiting.

(c) Concentrated borax solution made to a paste with slaked lime.

(d) Clay and boiled oil.

(e) China clay, litharge, and boiled oil.

(f) Quicklime and old cheese.

It being in the nature of a cement to set, cements which are not solutions should never be stocked complete. Solutions should of course be kept in vessels closed air-tight. When a mixture of solids is made into a paste before use, time may be saved by keeping the solid ingredients mixed, so that only the final substance which makes the cement workable has to be added when the cement has to be used. Many pasty cements, as, for example, gum arabic and calomel, set with great rapidity, and if they have set in the mass they become useless. The changes which bring about the setting preclude the use of the cement again, even if it is ground up to powder. Many disappointments have occurred by would-be makers of cement for India rubber using vulcanized rubber. This substance is entirely insoluble in bisulphide of carbon or any of

the usual solvents of raw rubber. If raw rubber cannot be got, the vulcanized rubber must be devulcanized before any attempt is made to use it. This is best done by prolonged boiling in a dilute solution of caustic soda. The rubber must also be cut up very small, or the alkali will only devulcanize just the outside of the mass. This subdivision also greatly facilitates the subsequent solution of the rubber.

Another point to be borne in mind by cement makers is that unless water is included in the recipe, the ingredients should all be mixed in a perfectly dry state. This is specially in the case of cements which have to resist the action of water or steam. Too much importance, too, cannot be attached to having the surfaces to be joined perfectly clean. Any dirt will prevent or diminish the adhesion of the cement in which the action of holding together consists. Where dirt intervenes between the cement and the face of the joint, the cement will adhere to the dirt only, so that the strength of the joint at that point will consist solely in the adhesion of the dirt to the solid surface. It is also a rule conducive both to economy and success in the use of cements to use as little cement to make a joint as will completely cover the surfaces to be united. Any excess of cement above this makes a weak joint.—Oils, Colours and Drysalteries.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Open for Bags in Hungary.—Deputy Consul-General Hanauer reports from Frankfort, June 1, 1901:

Hungary, which has a flourishing milling industry, would now be a good market for flour bags and sacks, as the Austrian jute spinning and weaving trust has raised the price of these articles, so that, in spite of the import duty on the foreign bags, 1,200,000 sacks have come in from Germany. Agricultural associations exist in all districts in Hungary, and purchase sacks, implements, etc., for their members. These associations have a central representation at Budapest, called the Landesagricultur-Verein. Offers should also be made to the Ungarische Mühlenverband, Bálványutca 2, Budapest, and to the Hauptstädtische Mühlenverband, Ergyébettér 19, Budapest, Hungary. The two last named are millers' associations.

Russian Northern Railroad.—Deputy Consul-General Hanauer reports from Frankfort, May 25, 1901:

An imperial ukase decrees the building of the Russian Northern Railroad, which is to connect St. Petersburg, Tichwin, Tscherepovetz, Valogda, Bui, Galitch, and Viatka. This line is to be begun next year and will be built by the government, as also a branch from Bui, to connect at Danilow with the Moscow-Yaroslavl-Archangel line. A part of the latter is to be broad gage and a bridge is to be built to cross the Volga at Yaroslavl.

Preservation of Eggs in Germany.—Consul-General Guenther, of Frankfort, June 4, 1901, sends the following extracts from an article on the results of experiments in preserving eggs, which appeared in a recent issue of a technical journal.

Four hundred fresh hen eggs were subjected to the action of different substances for a period of eight months. At the expiration of that time, it was found that the eggs which had been put into salt brine were all spoiled; that those which had been wrapped in paper were 80 per cent bad; and that a like percentage of those which had been immersed in a mixture of glycerin and salicylic acid were unfit for use. Of the eggs which had been rubbed with salt, or imbedded in bran, or coated with paraffin, 70 per cent were spoiled; of those subjected to a coat of liquid glass, collodion, or varnish, 40 per cent; and of those which had been placed in wood ashes or had been painted with a mixture of liquid glass and boracic acid, or a solution of permanganate of potash, only 20 per cent were bad. Almost all the eggs that had been coated with vaseline, or had been placed in limewater, or in a solution of liquid glass, were in good condition.

Fire Automobile in Germany.—Consul-General Guenther, of Frankfort, May 15, 1901, reports that the Eagle Velocipede Works, of that city, has built an automobile for fire departments, which will be exhibited at the Berlin Exposition for Fire-Extinguishing and Life Saving Apparatus. The automobile, adds the Consul-General, carries four men, has a speed of about 11 miles an hour, and will be used to render first aid in case of fires.

Production of Light from Smoke in Belgium.—Consul Mahin, of Reichenberg, May 17, 1901, says that, according to a report from Brussels, a Belgian engineer by the name of Tobiansky has discovered a method by which smoke can be turned into light. In operating his device, the inventor collects the smoke from any kind of a fire and forces it into a receiver. It is then saturated with hydrocarburet, and a brilliant light results.

German Demand for Monazite Sand.—Consul Brundage reports from Aix la Chapelle, May 18, 1901, that the general manager of the Chemische Fabrik Rhenania, of that city (one of the largest chemical factories in Germany), desires to purchase 200 tons or more per year of what is commercially known as monazite sand. At present, this is obtained from Brazil, but the consul is informed that this sand exists in North Carolina and other parts of the United States, and he suggests that miners should communicate at once with the company named, giving ability to furnish, percentage of thorium, and prices delivered f. o. b. wharf, Newport News, Baltimore, Philadelphia, or New York.

Smoke-consuming Furnaces for Germany.—In connection with the much-mooted coal question, I have already in reports to the Department called attention to the fact that the time seemed to be ripe in Germany for the introduction of smoke-consuming furnaces, which, as is well known, are great fuel savers. The high price of coal has made the German manufacturers disposed to listen with favor to proposals to replace their old style furnaces by apparatus in which low grade coal and coal dust can be burned, and which, through almost complete combustion, are smoke consumers.

A German imperial commission has been making experiments in the consumption of coal dust in furnaces, and a recent report makes special mention of the "Schwarzkopff" apparatus. The Journal of the Society of Arts has also given a brief description of the same. It states that it is necessary in the first place to have a highly heated fire chamber for the ignition of the coal dust, for the higher the temperature, the quicker and more perfect will be the combustion. Contact with the boiler walls must be guarded against, as this interferes with ignition; the fire chamber must be lined with fireproof material, as it has to be kept constantly at a certain temperature. It is pointed out that such a fire chamber is not an inconvenience, but rather a special advantage in coal dust firing, because it insures perfect combustion, a high temperature of the gases at the start, and protection against the formation of "needle" flames. Also, after firing has ceased—for the night, for instance—the heat stored in the fireproof walls maintains steam pressure longer and steam is more quickly raised in the morning.

The managers of State institutions have been instructed to do all they can to prevent or to consume the smoke from their fires, and, if necessary, to have smoke-consuming appliances constructed. Municipal authorities have been asked to do the same. It would seem a propitious time for American builders of smoke-consuming devices to appear on the field. I think it can easily be demonstrated that at least some American devices successfully prevent the formation of smoke and make it possible to use low grades of coal, screenings, and dust, so that the cost of the plant is covered by the saving in the cost of fuel in two years. It seems to me advisable for our manufacturers of smoke-consuming furnaces to have experts investigate conditions here. I am convinced that a large and lucrative business can be established.—Richard Guenther, Consul-General at Frankfort.

Barrels in the Argentine Republic.—Consul-General Guenther sends the following, dated Frankfort, June 7, 1901:

French official reports say "that since Brazil imposes a higher import duty on flour in sacks than on flour in barrels, it is now shipped by Argentine merchants exclusively in the latter packing. The Argentine Republic would therefore offer a good market for cooper's machinery." Perhaps not only such machinery, but staves, would, under the circumstances, find a ready market in that country; at least our stave manufacturers may find it to their advantage to investigate the possibilities for their goods in the Argentine Republic.

Costa Rican Duty on Coffee.—Minister Merry writes from San José, June 19, 1901:

The Government of Costa Rica has passed a law abolishing the export duty on coffee on and after the 1st of September next. This duty, amounting to 1 cent (United States currency) per pound, it is expected will be recouped by the additional 50 per cent import duty on imported merchandise required by the law since April 28, 1901. The export duty on coffee has been a serious burden on producers, and the coffee industry being mainly in the hands of citizens of the Republic, the relief will be much appreciated. It is hoped that the law may continue in force until coffee—which is now the main product of Costa Rica—commands a higher price in the world's markets.

Communication with Iceland.—Consul Hughes, of Coburg, under date of June 3, 1901, sends the following information, obtained from German sources:

The mail boat of the United Steamship Company, of Copenhagen, makes eighteen trips a year from Copenhagen via Leith and Färder Island to Iceland, while another firm has arranged for a new service via different Norwegian ports and Färder Island. Two other firms have small boats which make regular trips between Norway, Scotland, Färder Island, and the eastern ports of Iceland. A Newcastle firm also sends during the summer one boat between Iceland and the different Norwegian ports. This development is especially noticeable, when one looks back on the deficient shipping facilities which have existed during past years.

Germany's Share in the Suez Canal Traffic.—Under date of June 5, 1901, Consul Monaghan, of Chemnitz, writes:

The following figures, taken from a German paper, show that Germany's share in the traffic of the Suez Canal has increased considerably at the cost of England. England's share is still large, but is growing smaller from year to year, and during the last ten years has fallen off 15 per cent. Since 1896, England's trade has dropped off about 227 vessels, of 286,359 registered tons, while Germany's has increased 140 vessels, of 926,650 tons. In 1896, England had 66.9 per cent of the total trade, and in 1900 only 56.7 per cent. Germany's share, on the other hand, increased from 9.3 per cent to 15 per cent. For a number of years, the largest ships using the canal have sailed under the German flag; further, Germany has, on the average, larger ships than England, for while the average size of the German vessels is 4,431 registered tons, the average size of British vessels is only 4,016 tons. Twenty years ago, only 15 German vessels passed the canal, and now the number has reached 462.

Market for Banana Meal in Europe.—Consul Hughes, of Coburg, under date of June 4, 1901, writes as follows:

Dried banana meal finds a ready sale in Europe, owing to its great nutritive power. So far as I can learn, Jamaica merchants are the only exporters of this article to Europe, but it seems to me our Southern States should pay some attention to the industry, which promises before long to be a large and paying one. As an addition to milk, soups, meat stews, etc., banana meal is very palatable, imparting a delicate, pleasant flavor. Great care should be taken in drying the ripe fruit to prevent any decayed parts getting into the meal.

Obstacles to American Bicycle Trade in France.—This office is in receipt of a letter from a United States trade journal, which says that the sale of American wheels in Europe fell off 60 per cent during the past year, and that our lead of $2,000,000 over Great Britain and Germany dwindled to $300,000. As one means for remedying this condition, I would say that the oft-repeated advice of American consuls and of dealers in American wheels outside of Paris should be taken more seriously. The merits of the leading American wheels are well known in France, but if the complaints concerning the handling of these wheels are well founded, it is little wonder that the sales have decreased. Instead of placing the wheels in the hands of a Paris agency, which retains a commission, goods should be sent direct to responsible dealers in all the leading cities in France, at prices that would enable them to be retailed at 250 to 300 francs ($48.25 to $57.90). If they must pass through the Paris agency, the retailer in the other cities should be given the wheels at a much lower price than at present. The idea that the superiority of the American wheel is a sufficient inducement to cause Frenchmen to buy it is a great mistake. In consequence of the increased use of automobiles in France, special inducements should be held out to those who are favorably inclined toward American bicycles. A leading dealer in this city showed me a number of wheels fitted with uneven French tires, instead of the neat tires usually found on American machines. He says the tires are placed on the wheels in Paris, and that it is not possible for him to buy American wheels such as he wishes to sell, unless he takes them equipped with these inferior tires. He also claims that foreign brakes are being placed upon American wheels. It is like a man ordering a pair of fine boots upon which are fastened cheap, uneven soles. Place American wheels in the hands of the retailer, enable him to sell them at a reasonable price with a fair profit, and furnish him with American supplies so wheels may be repaired when necessary, and the trade in France will increase.—Joseph I. Brittain, Consul at Nantes.

Food and Drink Supply of Paris.—Consul Haynes, of Rouen, writes as follows, under date of June 3, 1901:

The annual report concerning the food supply of Paris for 1900 contains some interesting figures. Here is the official average of what a Parisian eats and drinks in one year: Two hundred and forty-two eggs, 19.62 pounds of butter, 3.05 pounds of ready-cooked butcher's meat, 34.92 pounds of fish, 154.70 pounds of beef, 25.38 pounds of pork, and 27.83 pounds of fowl and game. This gives a daily average of two-thirds of an egg, 380 grains of butter, 57.12 grains of ready-cooked butcher's meat, 669 grains of fish, 6.81 ounces of beef, 1.11 ounces of port, and 1.21 ounces fowl and game. The Parisian drinks in a year 1.89 gallons of alcohol, 3.07 gallons of beer, 1.48 gallons of cider, and 44.9 gallons of wine. This gives a daily average of 0.0387 pint of alcohol, 0.067 pint of beer, 0.0334 pint of cider, and 0.99 pint of wine.

Demand for Milk Vessels in Siberia.—Consul-General Guenther, of Frankfort, May 7, 1901, says that according to the St. Petersburg Gazette, the production of butter in Siberia has increased during the past few years to a very marked degree. In the vicinity of Barnaul, for instance, there are at present three hundred creameries, against two in 1896. The demand for milk vessels has consequently assumed large proportions. A factory for the production of these articles has lately been established at Kurgan, but, as it can not even approximately supply the demand, the greater part has to be procured from Moscow. The consul-general suggests that West Siberia might afford a good market for United States manufacturers of milk vessels.

Exposition of Fisheries at St. Petersburg.—Consul-General Guenther sends the following from Frankfort, May 8, 1901:

The Imperial Russian Association of Fisheries will hold an international exposition in February and March, 1902, at St. Petersburg, for the purpose of showing the condition of the fresh and salt water fisheries of the world. The expense of the exposition will be defrayed by the association, the Crown, the municipal government, private contributions, and by charges for exhibition space and for the admission of visitors. Premiums will be awarded in the form of gold, silver, and bronze medals, diplomas of honor, and money prizes. The exposition will have nine departments, as follows: (1) Fisheries in general; (2) salt and fresh water fisheries; (3) implements used in the fisheries industry; (4) products of the fisheries; (5) manner and means for preserving fish; (6) arrangement of fish hatcheries; (7) fishing sport; (8) aquariums and their inmates; (9) scientific researches concerning the lives of fishes, etc.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

No. 1087. July 15.—*The Manufacture of Bronze Powder in Germany—*Mercerized Cotton in Germany—*Testing Agricultural Implements in Russia—*Port Improvements at Caribe, Venezuela—*Canadian Discovery for Preserving Wood—*Exhibition at Dessau, Germany—*Builders' Association in Austria—*German Commercial Association in Japan.

No. 1088. July 16.—*The Industrial Situation in Germany—Manchester Exports to the United States—Imports of the Canary Islands—*Trade Openings in the Transvaal—*Mahogany in South America—Cement in Peru.

No. 1089. July 17.—*New Method of Construction in the Netherlands—Customs Administration in Persia—Trade Notes from West Africa—Wharf Improvements at Puerto Cabello—*Moscow Trade with the United States—*Coke Briquettes in Germany.

No. 1090. July 18.—Textiles in Argentina—*French Opening for Spraying Machines—*Hints on East Indian Trade—*Wheat Crop of India—*Wheat Crop of Russia—*Exposition for Life-Saving Service in Frankfort—*Export of Russian Crabs—*Cable Service to Tampico.

No 1091. July 19.—Improvements of the River Loire—Wharf at La Boca, Colombia—*New German Fuel—Quinine Auction Sale at Batavia—*Exposition in Japan—Railroad in Dahomey—New Duties in Turkey.

No. 1092. July 20.—The Starch Trade in Egypt—*Packing Goods for Export—*New Railroads in Prussia and Saxony—*Proposed German Customs Regulations—*Dealings in Grain Futures in Austria—*Loss of United States Trade in Cape Colony—*Exposition of Decorative Art at Turin.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

TRADE NOTES AND RECEIPTS.

Adhesive Grease for Driving Belts is obtained according to the following receipt:

Tallow	50 parts
Castor oil, crude	20 "
Fish oil	20 "
Colophony	10 "

Melt on a moderate fire and stir until the mass cools.—Drogistische Rundschau.

Nitrated Filtering Paper.—Hardened filtering paper is obtained, according to a note in L'Union Pharm., by immersing the paper once in concentrated nitric acid (1.423 specific gravity), next washing it out well immediately and drying it. Hence the filtering paper may be said to be nitrated rather than hardened. Same is said to lose nothing of its filtering capacity, but to gain considerably in resistive power. This seems plausible, for imperfectly nitrated cotton is more resisting than the pure cotton wool from which it was produced.

Preservative Salt.—A preservative salt, which is said to be used in Russia for the preservation of caviar, is interesting in various respects. The salt constitutes a fine powder, possessing but a slightly salty taste. Qualitative analysis revealed the presence of salicylic acid, chlorine, sodium and boracic acid. The composition was finally found to be as follows: Sodium salicylate 10 parts, cooking salt 20 parts, boracic acid (powdered) 70 parts. A practical mixing test demonstrated that the mixture possessed exactly the same qualities as the original preparation, while a mixture of borax and salicylic acid, also concerned in this case, has a sickening, bitter taste.—Pharmaceutische Zeitung.

Glue for Attaching Cloth Strips to Iron.—To paste strips of cloth on iron in a durable manner, a special mixture of adhesive agents is required. Soak 500 grammes of Cologne glue in the evening with clean cold water in a clean vessel; in the morning pour off the water, place the softened glue without admixture of water into a clean copper or enamel receptacle, which is put on a moderate, low fire (charcoal or steam apparatus). During the dissolving the mass must be continually stirred with a wooden trowel or spatula. If the glue is too thick, it is thinned with diluted spirit, but not with water. As soon as the glue has reached the boiling point, about 50 grammes of linseed oil varnish (boiled oil) is added to the mass with constant stirring. When the latter has been stirred up well, add 50 grammes of powdered colophony and shake it into the mass with stirring, subsequently removing the glue from the fire. In order to increase the binding qualities and to guard against moisture, it is well to still add about 50 grammes of isinglass. Same is previously cut into narrow strips and placed, well beaten, in a vessel, into which enough spirit of wine is poured to cover all. When the solution has been accomplished the last-named mass is added to the boiling glue with constant stirring. The adhesive agent is now ready for use and is employed hot, it being advisable to also warm the iron. Apply glue only to so much surface as one is able to cover promptly with cloth strips. The latter are not pressed down with the hand, but with a stiff brush or a wad of cloth.—Werkmeister Zeitung.

MINING ON THE KLONDIKE.

The opening article in the July issue of Mines and Minerals, of Scranton, Pa., is an extensive and valuable description of Alaskan mining from the pen of the well-known engineer of San Francisco, Mr. A. J. Bowie.

Mr. Bowie gives a history of the development in the Klondike and a large amount of practical information about mining costs in that region.

He gives the output of gold from the Klondike as follows:

In 1897 the shipments of gold coming down the Yukon from the Klondike were not carefully segregated from the shipments from the camps on the American side of the boundary line, and for this reason there are no exact data at hand. The Department of the Interior of Canada estimated the yield of the Klondike for that year at $2,500,000. At the United States Mint at San Francisco the product was estimated at $2,000,000, which is the same figure stated by the United States Consul at Ottawa, Canada, who considered the estimate of the Department of the Interior of Canada as too high.

It will be well, therefore, to consider the lower estimate as correct and place the yield of 1897 at $2,000,000.

Since that year more exact statistics have been kept. The method employed is to obtain from all United States Mints and assay offices and private refineries and smelters, the amounts received by them from the Northwest Territory. Depositors are all asked source of gold, so that this record may be kept, and care is taken to avoid duplication of statements. The following record may therefore be considered reasonably correct:

1897		$2,000,000
1898.	Standard Oz.	Coining Value.
Gold	595,318.214	$11,038,478.00
Silver	160,996.14	187,341.00
Total		$11,225,819.00
1899.	Standard Oz.	Coining Value.
Gold	859,281.228	$15,986,627.50
Silver	229,788.95	267,390.77
Total		$16,254,018.27
1900.	Standard Oz.	Coining Value.
Gold	1,197,608.099	$22,275,510.64
Silver	290,920.35	337,467.60
Total		$22,612,978.24

The total output of the Klondike district (N. W. Territory) for the four years of its history is thus seen to have been $52,092,815.51.

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